

---

---

# **Pest Management for Small Animals:**

*A Training Manual for  
Commercial Pesticide Applicators  
and Registered Technicians  
(Category 7G)*

Edward D. Walker  
Julie A. Stachecki

---

---

## Preface

This manual is intended to prepare pesticide applicators in category 7G, pest management for small animals, for certification or registered technician status under the Michigan Pesticide Control Act of 1976, as amended. Read the introduction to this manual to understand your responsibilities for obtaining the appropriate credentials to apply pesticides and how to use this manual.

## Contributors

This manual, "Pest Management for Small Animals: A Training Manual for Commercial Pesticide Applicators and Registered Technicians," was produced by Michigan State University, Pesticide Education Program in conjunction with the Michigan Department of Agriculture. Principal participants in the project represented MSU, MDA and small animal industry professionals:

Carolyn Bullock, CMG, Academy of Animal Arts, Dearborn, MI

Robert Bullock, CMG, Academy of Animal Arts, Dearborn, MI

Sally Chandler, East Michigan Environmental Action Council, Birmingham, MI

Gina Davis, Certification Manager, Pesticide and Plant Pest Management Division, Michigan Department of Agriculture, Lansing, MI

Katherine Fedder, Manager Pesticide Programs, Pesticide and Plant Pest Management Division, Michigan Department of Agriculture, Lansing, MI

Dr. Nancy Frank, D.V.M., Animal Industry Division, Michigan Department of Agriculture, Lansing, MI

Marci Rich, CMG, The Posh Pup, Westland, MI

Dr Larry Herzog, D.V.M., Grosse Pointe Animal Hospital, Grosse Point Park, MI

Larry G. Olsen, Pesticide Education Coordinator, Michigan State University, East Lansing, MI

Dr. Peter A. Prescott, MVMA Executive Director, Okemos, MI

Dr. Mary Grace Stobierski, D.V.M., Epidemiologist, Bureau of Infectious Disease Control, Michigan Department of Public Health, Lansing, MI.

## Acknowledgements

In addition to the primary contributors, we would like to express our thanks to the following persons for leading the companion animal industry toward improved industry cooperation and practices. It was through their involvement and coordination with the Michigan Department of Agriculture that professional responsibilities were clarified: Ms. Evie Bain, Regency Kennel, Belleville, MI; Ray Bauman, CKO, Carnich Inn, Holland, OH; Ms. Rita J. Biddle, Esq. Owner, Samarland Kennels, DeWitt, MI; Laurie Brush, Dewitt, MI; Ms. Phyllis Duncan, Doggie Designer, Jackson, MI.

The following people are recognized for their reviews, suggestions and contributions to this manual: Donn Miller, Veterinary Technology Program, Michigan State University, East Lansing, MI; Miller Animal Clinic staff, Lansing, MI; Brian Rowe, Enforcement Manager, Pesticide and Plant Pest Management Division, Michigan Department of Agriculture, Lansing, MI; Sally Walshaw, M.A., D.V.M., University Laboratory Animal Resources, Michigan State University, East Lansing, MI; Leslie Johnson, Michigan State University, Outreach Communications; Paul Love, Photographer, St. Johns, MI; Ken Dettmer, Designer, Graphicom, E. Lansing, MI.

With permission, information has been adapted from the Pet Industry Joint Advisory Council (PIJAC) training materials. We greatly appreciate their willingness to share information for the betterment of the industry to ensure animal well-being and safe practices.

---

# TABLE OF CONTENTS

<b>Preface</b> .....	2
<b>Acknowledgments</b> .....	2
<b>Introduction</b> .....	5
<b>Chapter 1 Pesticide Laws and Regulations</b>	
Federal Laws .....	7
Michigan Laws .....	9
Review Questions .....	15
<b>Chapter 2 Pests and Integrated Pest Management (IPM)</b>	
Insects .....	17
Mites and Ticks .....	19
Damage Caused by Insects and Insect-like Pests .....	19
Integrated Pest Management for Animal Health .....	21
Review Questions .....	27
Key to Insects and Mites of Medical and Veterinary Importance.....	29
<b>Chapter 3 Pesticides</b>	
Pesticide Classifications .....	44
Classes of Insecticides/acaricides Used in Animal Pest Management.....	45
Formulations Used in Managing Small Animal Pests .....	47
Methods of Application .....	48
Pesticide Use Around Animals .....	49
Compatibility of Pesticides .....	51
Special Concerns Associated with Pesticide Usage .....	51
Review Questions .....	53
<b>Chapter 4 Pesticides and the Environment</b>	
Pesticide Fate .....	55
Groundwater Contamination .....	57
Effects on Nontarget Organisms .....	58
Review Questions .....	60
<b>Chapter 5 Pesticides and Human Health</b>	
Exposure: How Pesticides Enter the Body .....	62
Toxicity and Potential Health Effects of Pesticides .....	63
First Aid for Pesticide Poisoning .....	64
Safety: Protect Yourself from Pesticides .....	67
Review Questions .....	71
<b>Chapter 6 Pesticide Handling, Storage and Disposal</b>	
Handle Pesticides Safely .....	73
Store Pesticides Safely .....	74
Dispose of Pesticides Safely .....	76
Transport Pesticides Safely .....	77
Pesticide Fire Safety .....	77
Review Questions .....	79

## **Chapter 7 The Pesticide Label**

Parts of the Label .....	81
Additional Pesticide Information - MSDS .....	85
Review Questions .....	86

## **Chapter 8 Fleas**

Flea Life Cycle .....	87
Dog and Cat Fleas: Life History .....	88
Flea Management .....	88
Review Questions .....	92

## **Chapter 9 Mites and Ticks**

Mites .....	93
Mite Pests of Animals .....	95
Control of Mites on Animals or in Animal Environments .....	98
Ticks .....	99
Detection and Identification of Ticks .....	100
Important Ticks Affecting Animal Health .....	101
Management of Ticks on Animals .....	102
Review Questions .....	103

## **Chapter 10 Chewing and Sucking Lice**

Lice Life Cycle .....	105
Effects of Lice on Animal Health .....	106
Lice Management .....	106
Review Questions .....	107

## **Chapter 11 Flies**

Biting Flies .....	108
Management of Blood-feeding Flies .....	110
Nuisance Flies .....	110
Management of Filth Flies .....	111
Review Questions .....	113

<b>Appendix A: Caged Animals</b> .....	114
--	-----

<b>Appendix B: Birds</b> .....	119
--------------------------------	-----

<b>Appendix C: Resources</b> .....	124
------------------------------------	-----

<b>Answers to Review Questions</b> .....	126
--	-----

<b>Glossary</b> .....	131
-----------------------	-----

---

# INTRODUCTION

This manual presents basic pest, pest management and pesticide handling information for persons who apply pesticides on animals or in places where animals are kept — pest management for small animals, category 7G.

People use pesticides for many purposes. Pesticides protect humans, food and non-food crops, homes, pets and livestock, and keep various industrial processes pest free and functioning efficiently. To better protect the environment and human health by assuring the safe use and application of pesticides, the Michigan Department of Agriculture (MDA) administers the certification and registration program for pesticide applicators. Certification or registration requires obtaining the necessary knowledge to purchase and safely use pesticides.

In 1991, Regulation 636 was passed as part of the Michigan Pesticide Control Act amendments of 1988. This regulation requires persons who apply pesticides for a commercial purpose or as a scheduled and required work assignment in the course of his or her employment to be either certified pesticide applicators or registered technicians. Numerous types of businesses, activities and individuals are subject to this requirement. The following pest control categories are defined in Regulation 636:

- (1A) Field crops
- (1B) Vegetable crops
- (1C) Fruit crops
- (1D) Livestock
- (2) Forest
- (2A) Wood preservation
- (3A) Turfgrass
- (3B) Ornamental (exterior trees, shrubs and groundcovers)
- (4) Seed treatment
- (5) Aquatic (lakes, ponds, streams, etc.)
- (5A) Swimming pools
- (5B) Microbial (cooling towers, air washers, etc.)
- (6) Right-of-way
- (7A) General pest management (pests in, on or around human dwellings, institutions, food-handling establishments, etc.)
- (7B) Wood-destroying organisms

- (7C) Contractual public health
- (7D) Vertebrate
- (7E) Interiorscape
- (7F) Mosquito management
- (7G) Small animals
- (8) Public health
- (9) Regulatory
- (10) Demonstration and research

**To become a commercial pesticide applicator in category 7G, pest management for small animals, an individual must complete an application form, pay the \$50 certification fee and pass a written multiple-choice/true-false examination relating to the information found in this manual. Obtain an application form for commercial pesticide applicator certification from the nearest MDA office (telephone numbers and addresses are listed in Appendix C) or from your county MSU Extension office. When you are prepared to take the exam, call the MDA to reserve a seat at a scheduled examination time and location. Take your completed application form and check or money order for the \$50 certification fee to the exam site. The certification credentials you receive after passing the exam are valid for three years.**

To become a registered technician in category 7G, you must pass an examination that tests your knowledge of the general, “core” pesticide information found in this manual, chapters 1-7 only. Follow the same procedures as above for taking the exam. Next, you must undergo category-specific training. This training must deliver specific information to properly prepare you for your job tasks. The training must be approved by the MDA and administered by an MDA-approved trainer. Obtain an application for registered technicians and bring it to the exam site with the \$25 registration fee. The registered technician credentials you earn by passing the exam and going through training are valid for three years. For more information, refer to Chapter 1: Laws and Regulations, or call your regional MDA office.

This manual is not intended to provide all the information necessary for effective pest control with pesticides labeled for use on or around animals. Obtain up-to-date information about recommended materials and methods from labels, manufacturers, reference manuals, Extension specialists and professional associations. The

label carries important information about proper dilution rates, timing, placement and precautions when using pesticides for animal health reasons. The label is the law. Follow all directions on pesticide labels.

### **Suggestions for Studying This Manual**

This manual is designed to help applicators meet pesticide certification requirements. You may already know some of the material from your experience with pesticides. This manual has 11 chapters. A list of self-help questions is included at the end of each chapter. These questions are to help you study and are not necessarily the questions on the certification examination. If you have problems using the manual, please consult your county Extension agent, your supervisor or a representative of the MDA for help.

1. Find a place and time for study where you will not be disturbed.
2. Read the entire manual through once to understand the scope of the material and the

manner in which it is presented. A glossary at the back of the manual defines some of the terms used in the chapters.

3. Study one chapter of the manual at a time. Consider underlining important points or take written notes as you study the chapter.

4. Answer, in writing, the self-help questions at the end of each chapter. These questions are intended to help you study and evaluate your knowledge of the subject. They are an important part of your study.

5. Reread the entire manual once again when you have finished studying all of its sections. Review with care any sections that you feel you do not fully understand.

This manual is intended to help you use pesticides effectively and safely when they are needed. We hope that you review it occasionally to keep the material fresh in your mind.

---

## CHAPTER 1

# PESTICIDE LAWS AND REGULATIONS

### LEARNING OBJECTIVES:

After you complete your study of this chapter, you should be able to:

- Have a general understanding of the types of laws and regulations that may affect commercial pesticide applicators.
- Explain the difference between restricted use pesticides and general use pesticides and who can purchase and use them.
- Know what agencies administer and enforce the laws and regulations that affect commercial pesticide applicators.
- Determine who needs to be either a certified pesticide applicator or registered technician.
- Be aware of the importance of having up-to-date knowledge about how to comply with all laws and regulations.

---

Pesticide use increased from approximately 300 million pounds of active ingredient in 1964 to approximately 1 billion pounds of active ingredient in 1991. Approximately 275 million pounds of active pesticide ingredients were used for **non-agricultural** purposes in 1991. New highly sensitive measuring devices are detecting pesticides in groundwater and other parts of our environment. To protect the environment and human health, federal and state laws regulate the proper, safe use of pesticides. In this chapter, you will learn about the state and federal laws that regulate pesticide applicators.

### FEDERAL LAWS

Several federal laws regulate pesticide use. Both state and federal agencies enforce these laws. The following sections describe requirements of pesticide laws and which agency enforces each.



### FIFRA

The basic federal law regulating pesticides is the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), enacted in 1947. This law was amended in 1972, 1978 and 1988.

FIFRA is administered by the U.S. Environmental Protection Agency (EPA). The Michigan Department of Agriculture (MDA) has a cooperative agreement with the EPA to enforce the provisions of FIFRA in Michigan. The major provisions of FIFRA are:

- All pesticides must be registered with the EPA before they can be used or sold.
- States have the authority to certify applicators, register selected pesticides for use in those states, and initiate programs designed to meet local needs.
- The EPA has authority to develop rules establishing national standards for safe use, storage, transportation and disposal of pesticides.
- Pesticides must be classified as either “general use” or “restricted use.”
- Applicators who violate the provisions of FIFRA can be served a civil or criminal penalty:

**Civil penalties** – A private applicator who violates FIFRA after a written warning or other citation for a prior violation may be fined up to \$1,000 for each offense. A commercial applicator may be fined up to \$5,000 for each such offense.

**Criminal penalties** – An applicator who knowingly violates FIFRA is guilty of a misdemeanor. A commercial applicator may be fined up to \$25,000 and may be imprisoned for up to one year. A private applicator may be fined up to \$1,000 and imprisoned up to 30 days.

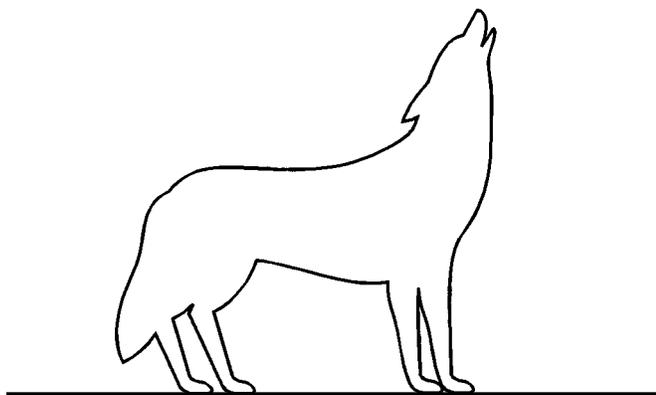
FIFRA defines the term “misuse” as “to use any pesticide in a manner inconsistent with its labeling.” It specifies that the following activities do not constitute misuse:

- Using a pesticide for a pest not noted on the label if the application is made to the plant, animal or site specified on the label.
- Any manner of application unless expressly forbidden by the label.
- Using a pesticide at dosages less (but not more) than the labeled dosage or frequency.

These exemptions apply only if the pesticide is otherwise used according to the label. Do not use these exemptions unless you are certain of their results. The exempted uses may not be covered by the pesticide manufacturer’s warranty.

## ENDANGERED SPECIES ACT

The Endangered Species Act became effective in the early 1990s. The MDA will enforce the pesticide-related provisions of the Endangered Species Act. The Act protects endangered species of plants and animals from pesticides by prohibiting application of specific pesticides within endangered species habitat ranges. For each pesticide product that has an effect on an endangered species, the Act requires that the labeling include a list of states and counties where the product may affect the endangered species and then restricts its application. County maps will be available where pesticides are sold or from your local county Extension office to further define habitat areas. For further information on endangered species, call the U.S. Fish and Wildlife Service, Department of the Interior, at (517) 337-6650.



## SARA TITLE III

Title III of the federal Superfund Amendments and Reauthorization Act of 1986 (SARA) is also called Emergency Planning and Community Right-to-Know. This legislation provides a means to protect people from chemical emergencies by requiring state and local agencies to gather information about the quantity and location of hazardous chemicals in their community. Dealers, pesticide application businesses, farmers and industrial facilities requiring pesticide applications are some of the groups that must comply with this law. The law is divided into numerous sections.

Section 302 (facility notification) requires anyone who stores a specified quantity of an EPA-designated “extremely hazardous substance” to notify proper authorities and provide the name of the person responsible for the storage facility. Examples of chemicals on this list include chlorine, bromine, formaldehyde and lindane.

Section 304 (emergency notification) requires that applicators or businesses report any release (spills, leaks, etc.) of an “extremely hazardous substance” above specific reportable quantities.

For more information on SARA Title III and the EPA-designated “extremely hazardous substance” list, call the DNR SARA Title III office (517-373-8481). Two MSU Extension bulletins also explain SARA Title III and how to comply with its requirements: Extension bulletin E-2173 is for pesticide users and Bulletin E-2174 is for pesticide dealers.

## FEDERAL FOOD, DRUG AND COSMETIC ACT

The EPA sets residue tolerances which are enforced by the federal Food and Drug Administration (FDA) under the Federal Food, Drug, and Cosmetic Act. The pesticide that stays in or on raw farm products or processed foods is called a **residue**. A **tolerance** is the concentration of a pesticide that can legally remain on the produce at harvest. The same pesticide may have a different tolerance on different products. Residues in processed foods are considered to be food additives and are regulated as such.

## TRANSPORTATION REGULATIONS

Shipping of pesticides and other dangerous substances across state lines is regulated by the federal Department of Transportation (DOT). The DOT issues rules for hauling these materials. DOT standards tell you which pesticides are dangerous to people and may create a health hazard during transportation.

## OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

The federal Occupational Safety and Health Administration (OSHA) is in the Department of Labor (DOL). OSHA recordkeeping and reporting requirements apply to employers with 10 or more workers. The records must include all work-related deaths, injuries and illnesses. Minor injuries needing only first aid treatment need not be recorded. A record must be made if the injury involves any of the following:

- Medical treatment
- Loss of consciousness
- Restriction of work or motion
- Transfer to another job.

Regardless of the number of employees you have, if a work-related death occurs or if five or more employees are hospitalized, OSHA must be notified within 48 hours. (Also, see Michigan Occupational Safety and Health Act in this chapter.)

## WORKER PROTECTION STANDARDS (WPS)

In October 1992, federal worker protection standards for agricultural employees were enacted. Requirements include but are not limited to:

- Establishment of restricted entry intervals
- Posting and notification of treated areas
- Use of protective clothing, safety devices, hand washing, and other methods of protection and decontamination
- Notification of poison treatment facilities and access to them.

These rules apply to persons involved with the production of agricultural plants. **The WPS rule does not apply to pest management for small animals.**

## MICHIGAN LAWS

The Michigan Pesticide Control Act primarily regulates pesticides and their use in Michigan. Pesticide applicators must be familiar with this Act, as well as the other state regulations below.

## MICHIGAN PESTICIDE CONTROL ACT

To assure that pesticides are properly registered and applied, the Michigan Legislature passed the Pesticide Control Act of 1976. The Act was amended in 1988. This legislation gives the director of the MDA authority to register or certify private and commercial applicators and to prescribe standards for certification and registration. The MDA

also registers, suspends and cancels pesticide registrations; investigates the use and misuse of pesticides; enacts rules; licenses restricted use pesticide dealers and firms performing pesticide applications for hire; and issues oral and written orders.



**Certification/registration requirements.** The Michigan Pesticide Control Act, P.A. 171 as Amended, requires any person who applies a pesticide product for a commercial purpose, or applies any pesticide in the course of his or her employment or other business activity for any purpose other than a private agricultural purpose, to be either a commercially certified applicator or a registered technician.

Pesticide applicators not required to be licensed by the Act, and who use only general use, ready-to-use pesticide products, are exempt from the certification and registered technician requirements. For example, a person who works at a hospital, school, factory, golf course or an apartment complex who uses only a general use, ready-to-use product for controlling a pest would not be required to be a certified applicator or a registered technician. (See page 10 for definitions of general use and ready-to-use pesticides.)

Two classes of applicators are defined under the law: private and commercial. Within each class, applicators may be certified applicators or registered technicians.

1) **Private applicators.** Persons using or supervising the use of restricted use pesticides to produce an agricultural commodity on their own or their employer's land, or on lands rented by them, are private applicators. "Production of an agricultural commodity" means production for sale into commerce and includes crops, livestock, ornamentals, forest products and other products regarded as agricultural commodities.

2) **Commercial applicators.** A commercial applicator is any person other than private applicators applying pesticides. There are two subclasses of commercial applicators:

Subclass A - Any person (including homeowners) who uses or supervises the use of restricted use pesticides (RUPs) for a non-agricultural purpose.

Subclass B - Any person who applies pesticides that are not ready-to-use in the course of his or her employment.

Applicators included in subclass A must be certified as commercial applicators. Those in subclass B have the option of becoming certified commercial applicators or registered technicians. Because pesticides are used in a wide variety of operations, commercial applicators are certified or registered in special commodity or site-specific categories (a list is provided in the introduction of this manual), such as small animal pest management.

**To become a commercial applicator** in category 7G, pest management for small animals, an individual must complete an application form, pay the \$50 fee and pass a written multiple-choice examination relating to the information found in this manual. Application forms can be obtained from the MDA or from MSU Extension offices. Persons should obtain the training manual(s) from the Extension bulletin system. When you feel you understand the contents of the manual, call the regional MDA office and schedule a time to take the examination on this material. Take your completed application form and certification fee to the exam site.

Commercial applicators who purchase or apply pesticides must keep records. (See State Law: Regulation 636 in this chapter.)

**Registered technicians.** The 1988 amendments to the Michigan Pesticide Control Act established a new classification of applicators: registered technicians. This classification includes people who are authorized to apply general use pesticides for a commercial purpose or apply general-use pesticides as a scheduled and required work assignment. A registered technician working for a licensed pesticide applicator firm may apply general use pesticides under supervision of a certified applicator and restricted use pesticide (RUPs) while under direct supervision. The intent of this portion of the Act is to establish minimum competency standards for all commercial applicators.

To become a registered technician in category 7G, you must pass an examination that tests your knowledge on the general “core” pesticide information found in this manual, chapters 1-7. Next, you must undergo category-specific training. This training must deliver specific information to properly prepare you for your job tasks. The training must be approved by the MDA and administered by an MDA-approved trainer.

All employees of kennels, dog grooming facilities, veterinary clinics, golf courses, hospitals, schools, municipalities, etc., **who apply pesticides other than general use, ready-to-use pesticides**, must either be certified applicators or registered technicians.

**Reciprocity.** Each state has its own certification regulations. An agreement between states to allow certified applicators in one state to use pesticides in the other state is called reciprocity. Currently, Michigan has reciprocal agreements with Indiana, Ohio and Wisconsin.

**Commercial pesticide application business license.** Any business established to apply pesticides for hire, including pesticides applied to animals, must obtain an **annual commercial pesticide applicator license** by sending an application and fee to MDA. Such businesses must employ at least one certified commercial applicator before the license can be issued. The certified applicator supervises the use of any general use or restricted use pesticides by registered technicians. (Note that the business is licensed, not the applicator.) The business must also provide proof of insurance as required by Regulation 636.

An applicator may not obtain a **commercial pesticide applicator license** without first meeting the necessary hands-on experience requirements. Individuals applying for a new business license must have at least two years of pesticide application experience or the equivalent — one year of application experience and a four-year college degree in a related discipline.

**Restricted use pesticide dealer’s license.** Any person or business wishing to sell or distribute RUPs first must obtain an **RUP dealers license** from the MDA. The licensed dealer must keep records on the sale of any RUP and submit those records each month to the MDA. It is illegal to sell or distribute RUPs to anyone who is not a certified applicator.

**Penalties.** Significant criminal **penalties exist for violators** of the Pesticide Control Act:

- Private applicators can be fined up to \$1,000.
- Commercial applicators who knowingly violate this act can be fined up to \$5,000. If the violation is with malicious intent, the applicator can be fined up to \$25,000.

The MDA is responsible for investigating pesticide misuse and failures of pesticides to perform when used in accordance with label instructions. **If you have a complaint involving a pesticide**, notify the nearest MDA office. Delays in making a complaint greatly reduce the chances of a satisfactory investigation. The MDA needs to receive the

complaint within 60 days of the action. Make the complaint as soon as possible if you have reason to suspect pesticide misuse or failure.

## State Law: House Bill 4344

House Bill 4344, Public Act 131, amends the Pesticide Control Act 171. Among other things, this bill defines general use pesticide and ready-to-use pesticides as follows:

**General use pesticide** means a pesticide that is not classified as a restricted use pesticide.

**Ready-to-use pesticide** means a pesticide that is applied directly from its original container consistent with label directions, such as an aerosol insecticide or rodent bait box, which does not require mixing or loading prior to application.

Persons who use pesticides for a non-licensed, commercial purpose and who apply general use pesticide directly from the manufacturer's container (i.e. "ready-to-use") are exempt from certification or registration requirements. Aerosols, pump sprays, strips, ready-to-use baits, etc. are included in the "ready-to-use" group.

This bill amends Section 21A of Michigan Pesticide Control Act, making it illegal for a local unit of government to enact, maintain, or enforce an ordinance, regulation or resolution that is different from the Pesticide Control Act unless an unreasonable adverse effect is present or the local unit will be in violation of another Act. In both cases, the Agriculture Commission must approve the local ordinance.

## State Law: Regulation 636 – Pesticide Applicators

Regulation 636 was issued and implemented in 1991 as part of the Michigan Pesticide Control Act amendments of 1988. This regulation directly affects persons and businesses that apply pesticides for hire, such as performing flea shampoos, or dips on animals for pay. The following are some of the primary components of Regulation 636 of the Michigan Pesticide Control Act and are not intended to represent the regulation in its entirety. Check the actual regulation for details.

Regulation 636 expanded the pesticide **record-keeping** requirements. All commercial applicators shall maintain records of pesticide use for a time period not less than the following:

■ **General use pesticides.** One year following application.

■ **Restricted use pesticides.** Three years following the application.

All records shall contain the following:

- A) The name and concentration of the pesticide applied
- B) The amount of pesticide applied
- C) The target pest or purpose
- D) The date the pesticide was applied
- E) The address or location of pesticide application
- F) Where applicable, the method of application.

The records must be made available to the MDA upon request.

Regulation 636 also enacted the **registered technician** classification for pesticide applicators as a minimum competency standard. Part of Regulation 636 and the registered technician program involves **approved trainers**.

Approved trainers are certified applicators who have two years' experience in the category they intend to train in and who have participated in a designated seminar to earn credentials making them eligible for training registered technicians.

Regulation 636 also provides an exemption from some provisions of the Act for **incidental uses**. An individual or firm may make a written request to the MDA for an exemption to the registered technician or certified applicator requirement if they meet the following conditions:

- A general use pesticide is used
- The person is not regularly engaged in the application of pesticides for hire
- The pesticide application is an integral part of another operation.

## State Law: Regulation 637

Regulation 637 of the Michigan Pesticide Control Act primarily affects commercial pesticide applicators and their pest management operations in several ways.

RULE -

- 1-3) Establishes definitions and terms
- 4) Requires specific conduct of pesticide applicators to protect people and the environment
- 5) Establishes a registry of persons who must be notified before pesticides are applied on adjacent properties
- 6-7) Requires the use of containment structures for certain mixing/loading and washing/rinsing operations
- 8) Defines acceptable means for disposing of pesticides and pesticide-containing materials

- 9) Requires the use of protective equipment
- 10) Addresses avoidance of off-target drift and use of drift management plans
- 11) Calls for the posting of certain areas treated with pesticides and notification of the public prior to right-of-way and community pesticide applications
- 12) Requires the use of service agreements
- 13) Prohibits false claims regarding pesticide safety
- 14) Requires applicator training in integrated pest management and use of IPM programs in certain areas
- 15) Describes manners of pesticide use in and around schools
- 16) Establishes a registry of certified organic farms.

Obtain a copy of Regulation 637 to understand the components of each rule and how your pest management practices must comply. Regulation 637 became effective in 1992.

## **FEDERAL LAW: ANIMAL WELFARE ACT OF 1976 (9 CFR PARTS 1, 2 AND 3)**

The federal Animal Welfare Act of 1976 is administered and enforced under the authority of the United States Department of Agriculture, APHIS, Veterinary Services, Regulatory Enforcement and Animal Care (REAC). This regulation outlines specifications for the humane handling, care, treatment and transportation of dogs, cats and other small animals being used for certain types of activities such as research and exhibition (zoos, circuses, etc.). Large-scale breeders involved with sales to pet shops are also covered under this law. Persons working in the small animal industry should obtain a copy of this regulation and become familiar with and comply with its contents. This Act establishes practices that aim to accomplish complementary goals to the Michigan Pesticide Control Act: proper management of the environment and control of pests of small animals in a way that protects humans, animals and the environment.

Requirements of the Animal Welfare Act support the activities of an integrated pest management program by requiring sanitary and husbandry practices for animal well-being. For instance, specifications for maintaining acceptable housing to prevent pest or disease problems are outlined. Cleaning, sanitization and pest control information are in Part 3 – Standards, Subpart

A of the Animal Welfare Act. As stated in this Act, Part 3, Subpart A Sec 3.11:

(a) **Cleaning of primary enclosures.** Excreta and food waste must be removed from primary enclosures daily, and from under primary enclosures as often as necessary to prevent an excessive accumulation of feces and food waste, to prevent soiling of the dogs or cats contained in the primary enclosures, and to reduce disease hazards, insect pests and odors.

(b) **Sanitation of primary enclosures and food and water receptacles.** ((4)) Pens, runs, and outdoor housing areas using material... such as gravel, sand, grass, earth, or absorbent bedding, must be sanitized by removing the contaminated material as necessary to prevent odors, diseases, pests, insects, and vermin infestation.

(c) **Pest control.** An effective program for the control of mammals that are pests, insects and external parasites affecting dogs, cats and birds must be established and maintained so as to promote the health and well-being of the animals and reduce contamination by pests in animal areas.

## **STATE LAW: ACT 224 OF 1969, USE OF DOGS AND CATS FOR RESEARCH**

Act 224 of 1969 is administered and enforced by the Michigan Department of Agriculture Animal Industry Division. This Act regulates activities associated with dealers and facilities using animals in research. For more information, obtain a copy of the regulation or contact the MDA Animal Industry Division at (517) 373-1077.

## **STATE LAW: ACT 287 OF 1969, PET SHOPS, DOG POUNDS, AND ANIMAL SHELTERS**

Act 287 of 1969 is administered and enforced by the MDA Animal Industry Division. This Act regulates activities associated with pet shops and animal shelters, including the licensing and registration of those facilities. Certain activities associated with the sale of dogs and cats are also outlined.

The humane treatment of animals is a priority of the MDA Animal Industry Division. The MDA Animal Industry Division realizes this priority by authorizing and administering Act 224 (see above) and Act 287 of 1969, Pet Shops, Dog Pounds, and Animal Shelters. Both Act 224 and Act 287 stress the importance of sanitation and appropriate housing and care in the prevention of pests.

The above mentioned establishments are inspected to assure that animal facilities are clean and not overcrowded, and that wholesome food is properly provided to the animals. If problems are found, inspectors work with the company personnel to bring conditions up to high standards for the welfare of the animals. For more information, obtain a copy of the regulation or contact the MDA Animal Industry Division at (517) 373-1077.

## HAZARDOUS WASTE REGULATIONS

The Michigan Department of Natural Resources (MDNR) Waste Management Division administers both the federal Resource Conservation Recovery Act (RCRA) and state hazardous waste regulations (Act 64). Pesticide applicators must be aware of these regulations because many of the waste materials generated by an applicator may be hazardous. When waste is classified as hazardous, strict disposal and handling requirements must be followed. Questions about hazardous waste requirements should be directed to the MDNR Waste Management Division at (517) 373-2730.

Containers that have held certain products or wastes can be hazardous if they are not empty and triple-rinsed or power-rinsed. To ensure that a container is non-hazardous, triple-rinse or power-rinse (with a high-pressure nozzle) the

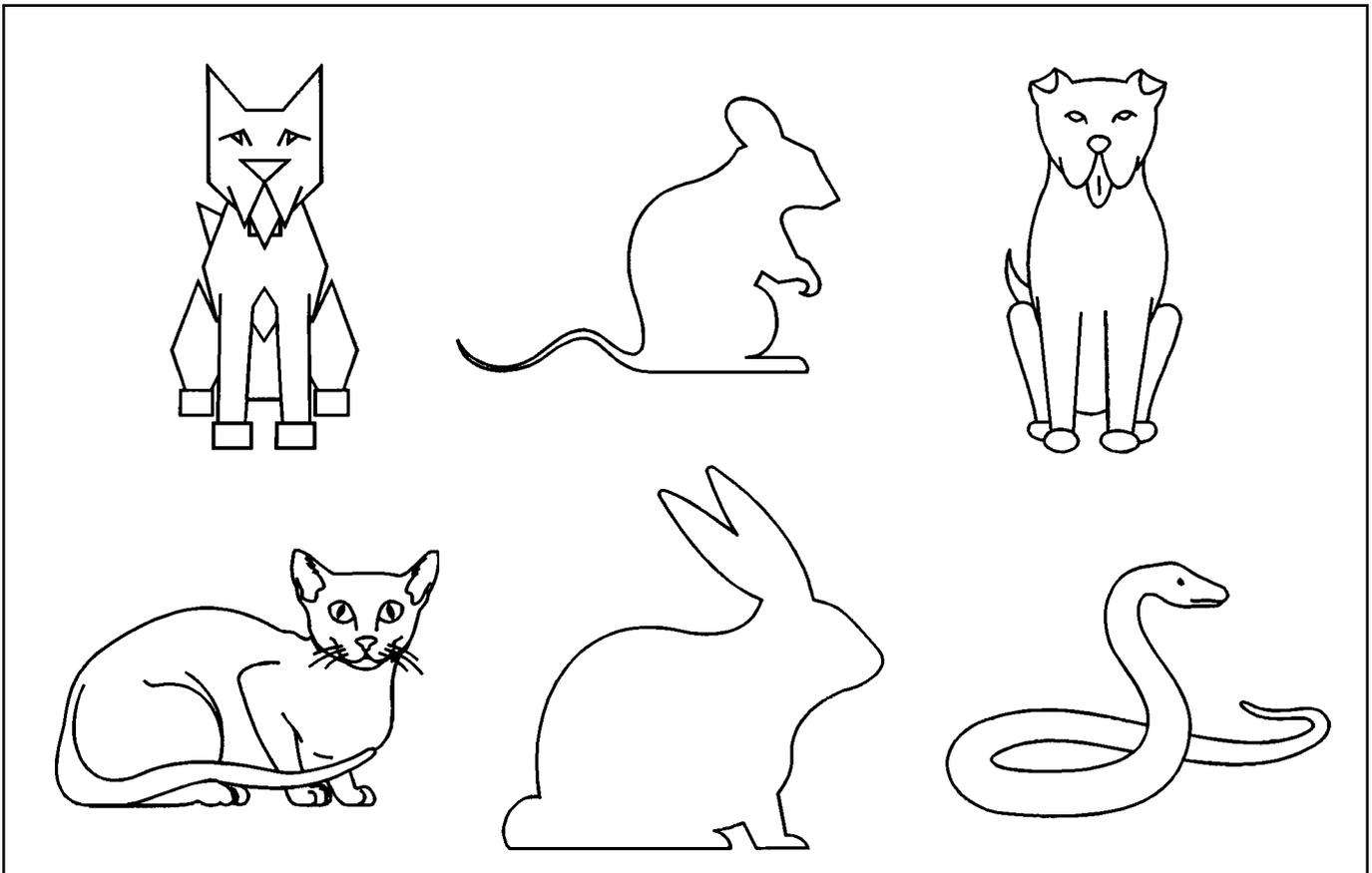
empty container before disposal. Such containers may be placed in a licensed Type II sanitary landfill. Remember that no free liquid chemicals can be placed in any landfill in the state.

## MICHIGAN OCCUPATIONAL SAFETY AND HEALTH ACT

The Michigan Department of Public Health (MDPH) and the Michigan Department of Labor (MDOL) jointly enforce the **Michigan Occupational Safety and Health Act (MIOSHA)**, Act 154, which was amended in 1986 to include what is commonly known as the Michigan Right-to-Know Act. This act incorporated the Federal Hazard Communication Standard into the MIOSHA Right-to-Know Act.

The MIOSHA Right-to-Know Act requires employers to:

- Obtain and retain Material Safety Data Sheets (MSDS) on all hazardous chemicals, including pesticides, for employee review. These can be obtained from pesticide distributors at the time of purchase or later upon request.
- Develop and implement a written employee training program.



- Ensure that all containers of hazardous materials are properly labeled.

If you have concerns or complaints related to MIOSHA Right-to-Know Act, notify either the

MDPH Division of Occupational Health at (517) 335-8250 or the MDL Division of Safety Standards at (517) 322-1809. Pesticides are not exempt from the provisions of the MIOSHA Right-to-Know Act.

---

## Chapter 1 – Review Questions

**Write the answers to the following questions, and then check your answers with those in the back of this manual.**

1. The basic federal law regulating pesticides is referred to as \_\_\_\_\_.
2. Restricted use pesticides can be sold only to \_\_\_\_\_.
3. Restricted use pesticides can be used by any person at any time, as long as they are purchased by a certified applicator. True or False?
4. For each pesticide product that may have an effect on an endangered species, the Endangered Species Act requires that the pesticide labeling include a list of states and counties where the product affects the endangered species and pesticide application is restricted. True or False?
5. SARA Title III requires that \_\_\_\_\_ who store(s) a specified quantity of an EPA designated “extremely hazardous substance” must notify proper authorities.
  - a. commercial applicators
  - b. veterinarians
  - c. farmers
  - d. anyone
6. The pesticide that stays in or on raw farm products or processed foods is called a - \_\_\_\_\_. A \_\_\_\_\_ is the concentration of a pesticide that can legally remain on produce at harvest.
  - a. residue, tolerance
  - b. tolerance, residue
  - c. reciprocity, toxicity
  - d. toxicity, reciprocity
7. Shipment of pesticides and other dangerous substances across state lines is regulated by the \_\_\_\_\_.
8. Who administers the pesticide applicator certification program in Michigan?
9. Any person (including homeowners) who uses or supervises the use of RUPs for a non-agricultural purpose must be a:
  - a. private applicator
  - b. commercial applicator
10. Employees who apply pesticides for hire (license required) as part of their work assignment must be either certified or registered. True or False?
11. Commercial applicators are not required to keep records of RUP applications. True or False?
12. What is reciprocity?
13. Any business established to apply pesticides for hire must obtain a commercial pesticide applicator license and employ:
  - a. three or more people.
  - b. at least one certified commercial applicator.
  - c. at least one registered technician.
  - d. none of the above. There are no hiring requirements.
14. Commercial and private applicators may be fined for unlawful conduct under the Michigan Pesticide Control Act. True or False?
15. Who investigates complaints about pesticide misuse and pesticide failures in Michigan?
  - a. Cooperative Extension Service
  - b. Farm Bureau
  - c. Michigan Department of Agriculture
  - d. Department of Natural Resources

16. The \_\_\_\_\_ administers both the federal (RCRA) and state (Act 64) hazardous waste regulations in Michigan.

17. Pesticide containers may be placed in a licensed Type II sanitary landfill only if they have been triple-rinsed or power rinsed. True or False?

18. SARA Title III requires that you notify authorities if you are responsible for storing a specified quantity of an EPA-designated "extremely hazardous substance." True or False?

19. What three Acts does the MDA Animal Industry Division administer and enforce?

---

## CHAPTER 2

# PESTS AND INTEGRATED PEST MANAGEMENT (IPM)

### LEARNING OBJECTIVES:

After you complete your study of this chapter, you should be able to:

- Explain the importance of correctly identifying pests.
- Explain the importance of understanding the life cycles and habits of pests.
- Name two physical characteristics that all insects have in common.
- List the four primary types of insect mouthparts and give an example of an insect that has each type.
- Define “metamorphosis”.
- List other types of pests that resemble insects or cause similar damage.
- Understand how endoparasites and ectoparasites are pests of animals.
- Explain the factors you should consider when deciding whether control of a pest is necessary.
- Discuss the five steps of an integrated pest management program.
- List and give an example of techniques used in pest management.

---

Accurately identifying pests is extremely important because different pests respond to different types of management tactics. Failure to identify the pest properly may result in wasted time, money, chemicals and effort. Each species of plant and animal can be identified by its scientific name. Although most plants and animals also have common names, the scientific naming system is universal — it assigns each organism one name to be used regardless of where it is found. This naming system categorizes animals based on their similarities: organisms with common characteristics are placed into large groups, then subdivided into smaller groups and finally given unique names.

In this chapter, you will learn to identify common characteristics of insect and insect-like pests of small animals. Examples of the types of animal injury caused by these pests will be discussed.

### INSECTS

All insects and related animals such as mites and ticks belong to a large group (phylum) called

Arthropoda. Members of this group are called arthropods and have segmented bodies; segmented appendages, some of which are modified for feeding; and a hard exoskeleton (exterior skeleton). On the basis of common characteristics, arthropods are separated into smaller groups called classes. The common classes of arthropods are Insecta, Arachnida, Crustacea, Chilopoda and Diplopoda. Most arthropod pests are insects or arachnids (mites or ticks from the class Arachnida).

Insects have unique external features and undergo developmental processes unlike those of other organisms in the animal kingdom. Correct identification of pests and a knowledge of their characteristics, development and behavior are keys to effective pest control.

### Physical Characteristics of Insects

The external characteristics of insect adults that set them apart from other animals are bodies with three regions — head, thorax, and abdomen — and three pairs of jointed legs.

**1. Head.** The head contains one pair of antennae, eyes and mouthparts. Antennae contain many sensory receptors for smell, wind and temperature. The four general types of mouthparts are chewing, piercing-sucking, sponging and siphoning.

**Chewing mouthparts** have toothed jaws that bite and tear food. Cockroaches, grasshoppers, ants and beetles have chewing mouthparts.

**Piercing-sucking mouthparts** consist of a long, slender tube that penetrates plant or animal tissue to suck out fluids. True bugs, aphids, mosquitoes and sucking lice have this mouth type.

**Sponging mouthparts** are tubular, tongue-like structures with a spongy tip to suck up liquids. This type of mouthpart is found on flies.

**Siphoning mouthparts** form a long tube for sucking nectar. Butterflies and moths have this type of mouth.

second segment. If two pairs of wings are present, they will be on segments two and three and are called forewings and hindwings. The forewings are modified in some insect groups. Beetles have shell-like forewings; grasshoppers have leathery forewings. Forewings of true bugs are part membranous, while forewings of moths and butterflies are membranous but covered with scales. Most hindwings of insects are membranous.

**3. The abdomen** has as many as 11 segments, though eight or fewer visible segments are common.

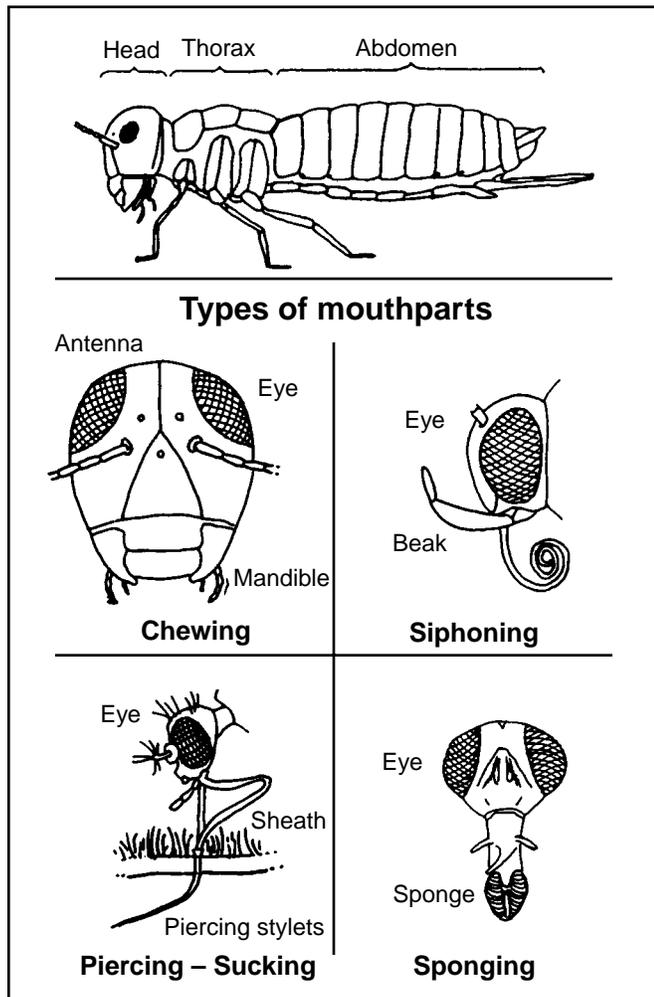
## Insect Development and Metamorphosis

The series of events from egg to adult is called the insect's **life cycle**. Life cycles vary among species and knowledge of the life cycle is absolutely essential to apply correct and timely pest management procedures.

Most insect reproduction is sexual — that is, a female's egg cell develops only after union with the male's sperm cell. The females of many insect species lay eggs. Some insects have special modes of reproduction such as those that develop from unfertilized eggs. The number of eggs produced by females varies from one egg to many thousands for some social insects.

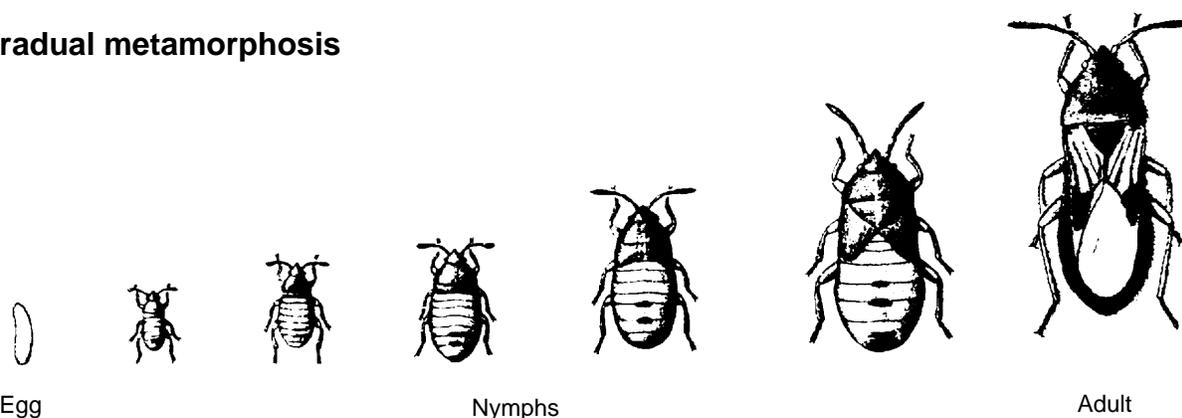
A newly hatched insect differs in size and often in form from the parents. The change that takes place before the young insect assumes the adult form is called **metamorphosis**. The degree of change varies widely. In some insects, it is slight and gradual; in others, it is abrupt and complete. Insects fall into three groups according to degree of metamorphosis:

- **No metamorphosis.** Body proportions and internal organs of these primitive insects remain similar after each molt. Examples: Collembola (springtails) and Thysanura (silverfish).
- **Gradual metamorphosis.** Changes are slight and gradual. The young or nymphs resemble the adults and feed in the same habitat, and wing development is external. Example: grasshoppers.
- **Complete metamorphosis.** Drastic alterations occur as insects grow through the egg, larval, pupal (an inactive, resting stage) and adult stages. This classification includes the majority of insects, such as flies and fleas.

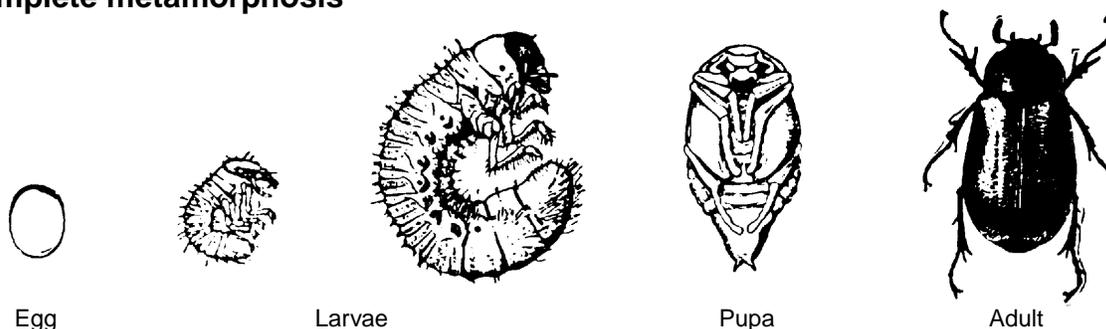


**2. Thorax.** The thorax consists of three segments with one pair of jointed legs per segment. If one pair of wings is present, they will be on the

## Gradual metamorphosis



## Complete metamorphosis



## MITES AND TICKS

Mites and ticks belong to the class **Arachnida**. Though they are relatives of spiders, scorpions and daddy longlegs, mites and ticks belong to their own scientific grouping within this class, called the **Acari** (a-CAR-ee). Two features distinguish mites and ticks from insects. Mites and ticks have:

1. **Four pairs of legs** (insects have three pairs).
2. **Two major body units**—the cephalothorax and abdomen (insects have three body units — head, thorax and abdomen).

Unlike insects, ticks and mites do not have segmented abdomens.

### Mite Development

The generalized mite life cycle begins when mites mate and the females lay eggs. The eggs hatch and six-legged **larvae** emerge. These larvae feed and molt to become eight-legged **nymphs**. Later, after feeding, the nymphs molt and become **adult male** or **female** mites. This entire life cycle can take as little as eight days to as long as four weeks, depending on the species of mite and the temperature and humidity.

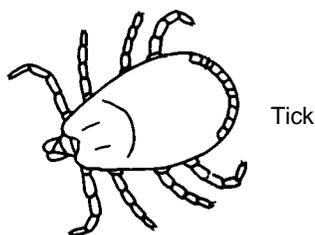
### Tick Development

Tick development starts with the egg stage, followed by six-legged larvae, eight-legged nymphs and eight-legged adults. Hard ticks have only one nymphal instar (that is, one molt to the nymph stage, followed by a molt to the adult stage). Soft ticks may go through up to seven nymphal molts, depending on the species of tick and its life cycle.

## DAMAGE CAUSED BY INSECTS AND INSECT-LIKE PESTS

Insects, ticks and mites injure animals, plants and structures in a variety of ways. The damage or discomfort of the host often provides clues to the identity of the pest, as well as the fate of the host (the organism the insect is on). For example, hair loss (alopecia) under the eyes and near or on the ears of puppies may be the first recognizable symptoms of demodectic mange mites. Consult with a veterinarian for correct diagnosis — sampling for burrowing mites requires a skin scraping. Scratching may be symptoms of fleas or ticks, and head shaking may indicate the presence of ear mites.

Animals can be troubled with pests on their bodies, in their bodies or in their environment. Many arthropods (spiders, mites and ticks) have evolved to live in close association with animals, and some have become true pests of animals. Arthropods may use animals as hosts for food, hosts to lay their eggs in, sites for resting and for other uses.



Arthropods may be endo- or ectoparasites. **Ectoparasites** live on the outside of the body of the host (animal the pest is associated with) more or less in permanent association. Fleas are an example of ectoparasites. They are pests of our pet dogs and cats. All the many species of fleas are ectoparasites on the bodies of wild or domestic animals. Even human beings can have ectoparasites such as head lice, follicle mites and crab lice. Arthropod pests that invade internal parts of the body are called **endoparasites**. Roundworms and hookworms are endoparasites.

Arthropods can be pests of animals in several ways:

- They may **invade and infest** the skin and tissues of animals, causing direct damage such as hot spots (moist eczema) and weakness.
- Arthropods can cause **blood loss** and tissue damage by **blood feeding**.
- Infestation and blood feeding can open the skin to **secondary infection** by bacteria.
- Blood-feeding can also cause **anemia** (weakness, lack of vitality due to blood loss or iron deficiency).
- Some arthropods have **venomous bites and stings** or have body secretions that cause the animal to have **toxic or allergic reactions**.

The direct damage and inflammatory reaction of animal skin to arthropod bites or body secretions is called **dermatitis**. Some animals develop extreme allergies to insect bites, stings or secretions. This kind of allergic reaction is called **hypersensitivity**. Veterinarians should be consulted to diagnose the cause of dermatitis. Once the cause is identified, the licensed veterinary technician, animal groomer, kennel manager or other trained animal pesticide applicator can be involved in treating the animal and controlling the problem.

Animals can be greatly **annoyed** by the presence and activity of certain arthropods. For example, cattle will bunch up and put their lowered heads together to seek relief when “fly strike” is severe. Dogs can be greatly bothered by biting fly attacks to the ears.

Many arthropods **transmit disease-causing agents** to animals, either by contact, body secretions or biting. For example, mosquitoes transmit viruses that cause encephalitis (inflammation of the brain) in horses and black-legged ticks can transmit Lyme disease among animals and humans.

The arthropod pests of animals fit into many groups or taxonomic categories. Table 2.1 lists these groups and gives both common and scientific names with an example of each group. The following chapters discuss in detail how each of these groups affects agricultural and companion animals, as well as how to detect, identify and manage the arthropod pests.

Among these arthropods are **arachnids** (the class Arachnida), including mites, ticks and poisonous spiders. Spiders will not be considered further in this manual, because they are not normally pests of domesticated animals.

Among the insects (the class Insecta), the important pests of animals belong in the following groups:

- Biting and non-biting flies.
- Invasive flies (flies whose maggots invade and infest animal flesh).
- Chewing and sucking lice.
- Fleas.

Stinging wasps and ants sometimes bother companion animals but will not be discussed in this manual.

The “key” at the end of this chapter, is an illustrated guide to identifying arthropods of medical and veterinary importance. To use the key, read the choices given by each number and select the choice that best describes the arthropod specimen you are trying to identify. Some knowledge of the body structure and life cycles of insects, ticks and mites is required to use this identification key. So, it is an educational tool as well as an identification guide. Give it a try! You will not be required to use the key to answer questions on the Michigan Department of Agriculture pesticide certification exam. You will need to be able to identify the general appearance of arthropod pests of animals by looking at a drawing similar to those found in later chapters, i.e., the difference between a mite and a flea.

**Table 2.1 Major groups of arthropods affecting animal health.**

Group	Scientific Name	Example
Class Arachnida		
Mites	Order Acari	<i>Sarcoptes scabiei</i> Scabies or itch mite
Ticks	Order Acari Class Arachnida	<i>Dermacentor variabilis</i> American dog tick
Class Insecta		
Biting flies	Order Diptera (Mosquitos, Black flies, Biting midges, Deer and horse flies, Stable fly, horn fly, sheep ked)	<i>Stomoxys calcitrans</i> Stable fly, dog fly
Nonbiting flies	Order Diptera (Face fly, house fly, eye nats, other filth flies)	<i>Musca domestica</i>
Fleas	Order Siphonaptera	<i>Ctenocephalides felis</i> Cat flea
Chewing lice	Order Mallophaga	<i>Trichodectes canis</i> Dog chewing louse
Sucking lice	Order Anoplura	<i>Linognathus setosus</i> Dog sucking louse

## INTEGRATED PEST MANAGEMENT FOR ANIMAL HEALTH

**Agricultural animals** (those used for production of food and fiber—livestock) and **companion animals** (pets such as dogs and cats) may be affected by arthropod pests. These pests must often be managed, controlled or prevented. Managing arthropod pests of animals can improve the living conditions, health and well-being of animals and humans. The principles of **integrated pest management (IPM)** apply to the operational practice of pest control for animals, whether the pests are actually on the animals or in the environment the animals occupy. IPM can be defined as “the use of all available tactics or strategies to manage pests so that an acceptable yield and quality can be achieved economically with the least disruption to the environment.”

Establishing an IPM program for pests of animals follows the same five steps outlined for managing any pest (weeds, diseases, etc.).

### 1. Detection

The first step in an IPM program is pest detection. Detection requires thorough and regular

monitoring of animals for pest infestations or other signs and symptoms that indicate a pest is present on the animal or in the environment where animals live. Observing an animal’s body, feces, living quarters, bedding, surroundings and behavior will help you discover potential pest problems. For example, if a pet dog is scratching or chewing more than usual, this behavior may cause the owner to suspect fleas and, therefore, to inspect the dog’s body to see if fleas are present. More severe conditions will require a veterinarian’s diagnosis of the health condition. The problem may be inhalant allergies or a secondary bacterial infection that should be treated only by a licensed veterinarian.

Animal health management requires frequent and routine monitoring. Frequent observations allow for early pest detection. Early detection of small pest populations may allow for more control options. Some control measures may work on limited numbers of pests but not on larger populations. Early pest detection also reduces or prevents the discomfort that would be caused by the pest if its population were to increase.

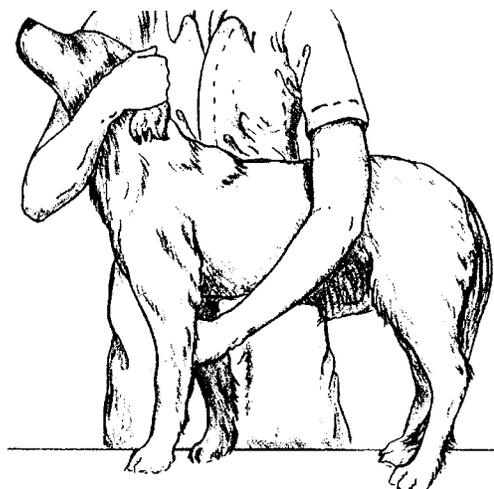
Commonly the pet professional is not around the pet routinely enough to maintain a pest monitoring program. The groomer is often faced with

**Table 2.2 Common Questions Asked by Pet Professionals**

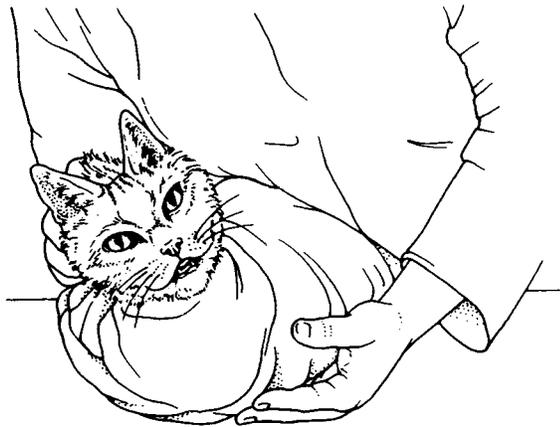
1.	Where on the body is the pet scratching?
2.	Have you recently bathed your pet?
3.	Did you use a pet shampoo appropriate for this breed?
4.	Does your pet scratch all the time or only during certain times of the year? Have you looked for fleas?
5.	Was your carpet recently cleaned at home?
6.	Have you recently installed new carpet?
7.	Are you using carpet fresheners?
8.	In the winter, does the pet lie in front of heat vents? Do you use a humidifier?
9.	When was the last professional grooming of your pet?
10.	If the pet is scratching the head area, have you looked into the ears for hair, insect-type pests or infection?
11.	If the pet is chewing or scratching the anal area, have you consulted with a veterinarian?
12.	Has your animal's veterinarian prescribed drug therapy for a scratch-itch syndrome, and are you administering it per directions?
13.	What type of food are you feeding your pet? Has this been a recent diet change recommended by your pet's veterinarian?
14.	Have you treated for fleas? Did you treat the pet, its bedding and the entire house at the same time? (See Chapter 8 for flea management and control information.)
<p>You may have other questions that lead to answers for easing a pet's discomfort. <b>Pet professionals should never attempt to make veterinarian diagnoses.</b></p>	

a one-time opportunity to determine if an insect pest is causing the animal's discomfort. When a pet owner brings in an animal and says, "My pet is scratching," information must be obtained from the pet owner. Table 2.2 lists some questions that may help you get the information you need to provide the animal relief. Never attempt a diagnosis that should be made by a veterinarian. Always refer your client to a veterinarian if you don't find or cannot identify the pest problem.

Persons who handle animals should be trained in correct handling and restraining techniques to avoid injury to the handler and the animal. Animals are often apprehensive when at veterinary clinics or grooming facilities and should be handled with extreme caution. A pet owner may be able to examine a pet easily at home in familiar surroundings and the animal may show no



Source: Manual of Clinical Procedures in the Dog and Cat



Source: Practical Animal Handling

resistance. Animal aggression may become obvious in strange surroundings or the animal may react unpredictably out of fear. Correct use of restraining holds and devices may benefit both the animal and the handler. Inspecting an animal for pests may be accomplished effectively with two persons—one handler-restrainer and the other as examiner. Wrapping a cat in a heavy towel, making sure the forelegs and hindlegs are secure, can prevent handlers from being scratched or bitten.

Not all animals will require firm restraining. The amount of restraint needed will depend on the environment and the animal's behavior. Animal behavior will vary greatly and handlers must learn to "read" the animal's body language. Speak to the animal initially in a soothing voice to prevent startling it. Use the animal's name when approaching it. If necessary, speak firmly to the animal. Verbal restraint can be a useful supplement to the physical restraint of pet animals. Obtain animal handling training from an experienced professional to protect yourself and the animal.

## 2. Identification

After a possible pest has been detected, the second step in an IPM program is to **identify** the organism to determine whether it is indeed the organism causing the discomfort or disorder. The identification of the problem, pest and/or the problem the pest is causing the animal, such as dermatitis, should be made by a veterinarian. Correct pest identification allows the animal manager to gain information about its life cycle and biology so management measures can be targeted at the pest's susceptible life stage. To follow the example of our pet dog's scratching behavior, it would not make sense to apply flea control measures to alleviate the itching symptoms if the dog actually has a scabies mite infestation or a dermal allergy to house dust mites or a food allergy.

## 3. Economical or Medical Significance

After detection and identification of the pest, the animal owner, groomer, kennel operator, veterinarian or pest management applicator must decide if the **pest is present at an economically or medically significant level**. A veterinarian must be consulted on medical conditions, such as dermatitis and its cause.

In agricultural settings involving livestock, it is often difficult to establish an **economic injury level** above which pest damage occurs. For instance, owners may observe scratching, licking or other behaviors and signs that the animals are irritated. These irritations may not cause any direct or topical (skin surface) problems. But if the irritation persists it may cause the animals enough stress to result in reduced milk or meat production—an indirect effect and an economic loss. Just before or at the point of economic loss, the pest should be controlled to relieve the stress and prevent further losses.

For companion animals, pest problems are often not tied to yield or economic loss but rather a **perception by the owner or kennel person that the animal suffers from the presence and activities of a pest**. Animal owners or veterinarians may make medical judgments on the basis of symptoms caused by pests. These judgments then are used as a basis for pest management decisions.

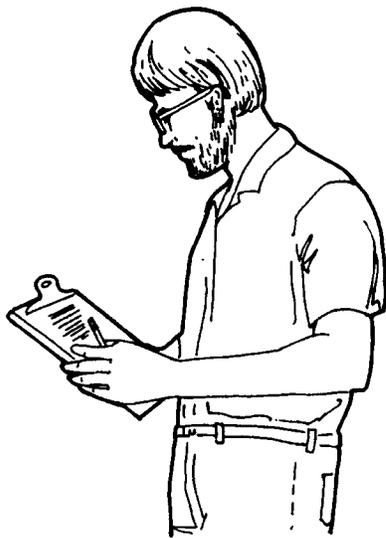
## 4. Method Selection

After detection and identification of a pest on an animal and determination that the pest is causing harm, it is time to **select a method or methods for managing the pest**. Depending on the situation and the nature of the problem, pesticides may or may not be required. Usually a com-

bination of pest control methods results in the most effective pest management. In any case, the methods should be effective, practical, economical and environmentally sound. Consult with a licensed veterinarian before treating pregnant or lactating dogs or cats for flea or mite infestations. These animals or their young may be negatively affected by a pesticide treatment.

## 5. Evaluation

After applying the chosen pest management procedures, **evaluate** their effectiveness. Keeping records and evaluating pest control techniques is necessary in a successful IPM program. Evaluation can include inspection of the animal and its premises to determine the level of pest control achieved and regular checks thereafter to determine if the pest returns to unacceptable levels.

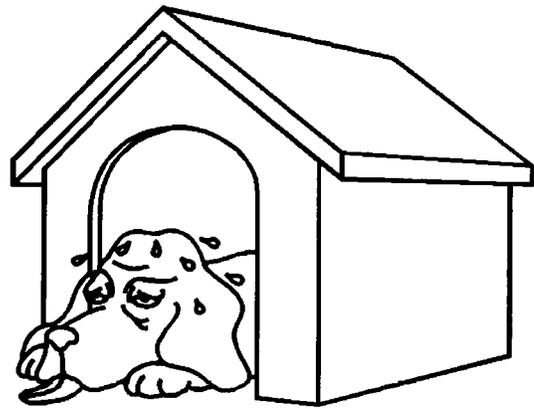


## Techniques Used in Pest Management

All types of pest management strategies that protect animals from arthropod pests should be considered. Combining several strategies achieves the most effective and efficient control. Integrated pest management strategies include biological, cultural, mechanical, physical, chemical (pesticides), use of resistant breeds, sanitation in the animal's environment and legal quarantines to prevent spread of pests.

**Biological controls** introduce, encourage and artificially increase plants and animals that are parasites or predators of pests. Biological controls are most commonly used to manage insects, mites and some weeds in agricultural or landscape settings.

**Cultural pest control** includes maintaining overall good health of the animals. A healthy animal can



tolerate low levels of pests better than a weak or stressed animal. Animal diets should be well balanced and provided at consistent intervals and in appropriate portions. If animals are kept indoors, provide adequate ventilation to prevent heat stress or the spread of diseases such as kennel cough. Provide outdoor animals shelter, especially during severe weather. Population densities must be proportional to available space, food supply and water. Overcrowding may encourage pest outbreaks, whether in a cage, kennel, barn or pasture setting. Proper and routine grooming reduces the opportunity for pests to become established.

Animal ailments can be influenced by the species, diet, living conditions and treatment of the animal by the owner/manager. When any one or a combination of these things is unsatisfactory, the animal is predisposed by poor living conditions to acquire a pest problem. A healthy animal living in a stress-free and sanitary environment is less likely to suffer pest problems.

**Mechanical tools** for animal pest management may include grooming combs, brushes and flea combs with closely spaced teeth to monitor for insects and ticks. The pet owner should be instructed to vacuum living quarters regularly to remove flea larvae, eggs and their food. The vacuum bag should be changed and discarded after each use if a known flea problem exists. Electronic devices such as lights that attract flying insects may be used around barns or other animal quarters to reduce some nuisance pests. Trapping rodents that may be carriers of pests is also a preventive mechanical control measure. Ultrasonic collars and other devices have not been found to be effective.

**Physical control** of animal pests may include the use of sticky flypaper to reduce nuisance flying insects in confined areas. Physical control may also include cages that separate the animals in your care from one another. Preventing contact

between animals will reduce the spread of insects from infested animals to non-infested animals. When an infested animal is removed from a cage or kennel, the area should be thoroughly cleaned and disinfected to prevent contamination of the next animal placed in this confinement area.

Use of **pest-resistant breeds** and breeds adapted to the conditions of the area where they are raised will avoid or reduce the effect of pests. Using breeds that tolerate the climatic changes and temperature extremes that occur in Michigan will help reduce the likelihood of stress and pest problems. Some animals have been bred for disease resistance and other qualities that result in reduced problems, while other species still show signs of intolerance even in low-stress situations.

**Sanitation** is the foundation of most animal pest management programs. Keeping kennels, pet exercise areas and homes as clean as possible discourages pest invasion by eliminating food sources and places to breed and live. Cleaning animal bedding and the surfaces of cages and other animal confinement with disinfectants kills pathogens and reduces the spread of disease.



**Quarantines** help reduce the spread of pest problems. When introducing a new animal to an existing laboratory setting, kennel or other group of animals, isolate the new animal and observe it for a period of time to confirm that it is pest free before grouping it with other animals. Within an established group of animals, separate those that are suspected to be sick or infested with a pest until the problem is identified and corrected.

In some pest situations, veterinarians or licensed veterinary technicians may not differen-

tiate between pest management and medical treatment of the animal. Heavy flea infestations on dogs, for example, can lead to secondary dermatitis and flea bite allergies that require veterinary care. The fleas are considered the arthropod pest that caused these undesirable conditions on the animals but the conditions are being treated medically. To treat the wounds without eliminating the cause (fleas) would be pointless.



Isolating new animals and observing them for a period of time, confirming that they are pest free, will prevent the spread of unknown pests. Clean environments are also essential to pest management.

Adopting a holistic, “IPM attitude” toward the management of pests of animals will help reduce pest problems. It is possible to manage a pest without any true medical treatment. Simply changing environmental conditions may prevent or eliminate a pest. Veterinarians may need to consult entomologists or commercial pesticide applicators for advice on pest life cycles or management strategies.

**Pesticides** are used in IPM programs for animal pests. Often, they are used in combination with other methods of prevention and control or used when other methods have failed or do not apply. For example, there currently are no effective environmental, cultural or other management options for deer flies and horse flies. Thus, insecticides or repellents on animals are the most reliable pest management alternatives.

Sometimes pests can be effectively managed with drugs, chemicals that veterinarians administer or prescribe. When a product is labeled as a drug, it is approved and regulated by the Food and Drug Administration, not the Environmental Protection Agency. An example of a drug that has antiparasitic properties is ivermectin (under trade names such as Ivomec®). This drug is injected or given orally to an animal to rid the animal of certain ectoparasites and endoparasites. An example of an insecticide that is given to animals like a

drug is Proban® for the management of fleas. Some animals treated with a drug and later exposed to another pest management chemical treatment have gotten sick. It is important that owners are made aware of the treatments administered to their animals and that they communicate this information to other handlers of the animal. Animal groomers, kennel owners and farm workers should ask for this information before administering any type of pest treatment. Ask product sales representatives, the manufacturer or a veterinarian about any possible negative interactions that may result between the products you use and other products that the animal may be exposed to. You are responsible for this knowledge. Obviously the animal cannot control these situations.

People responsible for maintaining a pest-free and healthy environment for animals must often decide whether to deal with pests as a medical problem with drugs as the sole treatment, or as a pest management problem, where IPM and possibly pesticides or drugs would be used. Treating only the damage caused by a pest and not controlling the pest will result in future injury. Animal pest problems should be controlled through environmental management and animal treatment.

Pesticide use on and around animals requires special care. **Pesticides may be toxic to the animals being treated.** The applicator must consider **dose-response relationships** and **pesticide choice** carefully when making applications. Smaller animals cannot tolerate the same dose of certain pesticides as well as larger animals. An applicator may need to consult a veterinarian to determine the appropriateness and timing of pesticide applications on animals. Before any



Professionals know the proper techniques for applying pesticides to animals and wear the proper personal protective equipment.

pesticide application is made to an animal or in its environment, the applicator should read and thoroughly understand the directions for use on the label. When heavy infestations occur, pet owners should consider obtaining professional pesticide applicator pest management help.

---

## Chapter 2 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. What unique external characteristics do adult insects have?
2. Which is NOT a type of mouthpart for insects?
  - a. Piercing-sucking
  - b. Filtering
  - c. Siphoning
  - d. Sponging
  - e. Chewing
3. \_\_\_\_\_ is characterized by egg, larval, pupal and adult stages and includes the majority of insects.
  - a. Gradual metamorphosis
  - b. No metamorphosis
  - c. Complete metamorphosis
4. What is a host?
5. Endoparasites live INSIDE the host body. True or False?
6. What are the causes of dermatitis?
7. List the four groups of important animal insect pests.
8. Define IPM and explain the five components of an IPM program.

9. Why is early detection of pests important?

12. Identify and describe the fifth and final step of an IPM program.

10. Why must the animal manager identify the pest?

13. What must be considered when pesticides are used on or around animals?

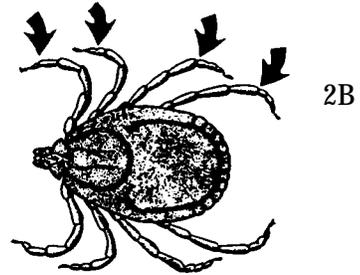
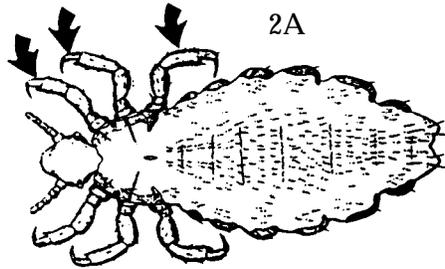
11. In what settings are economic injury levels of greatest concern?

14. List five or more strategies/techniques used in IPM programs and briefly describe each.

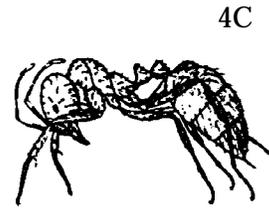
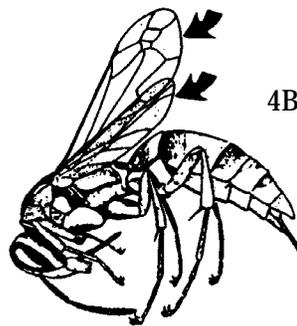
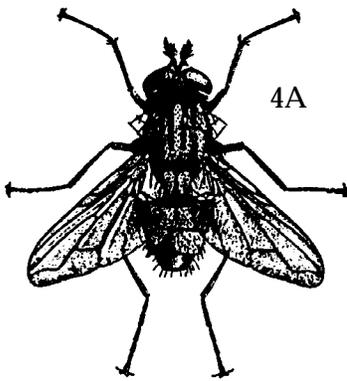
# Key To Insects, Ticks and Mites of Medical and Veterinary Importance

Source: North Carolina State University Cooperative Extension Service

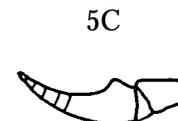
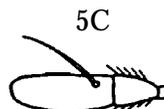
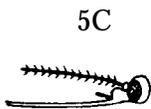
- 1. Having 6 or 8 legs (Fig. 2) ..... 2
  - Legless and wormlike maggots (Fig. 3) ..... 34
- 2. Having 6 legs and a distinct head (Fig. 2A) ..... 3
  - Having 8 legs without a distinct head (Fig. 2B)..... 32



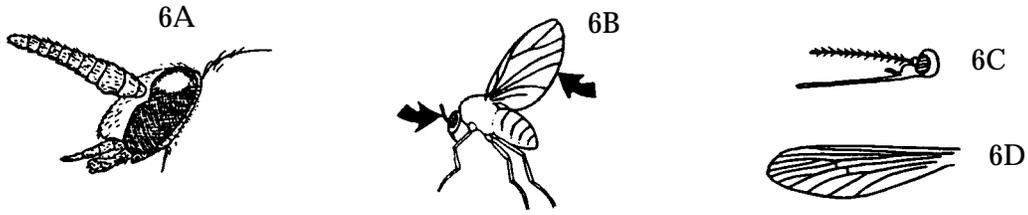
- 3. One pair of wings (Fig. 4A) ..... 4
  - Two pairs of wings or no wings (Fig. 4B, C) ..... 21



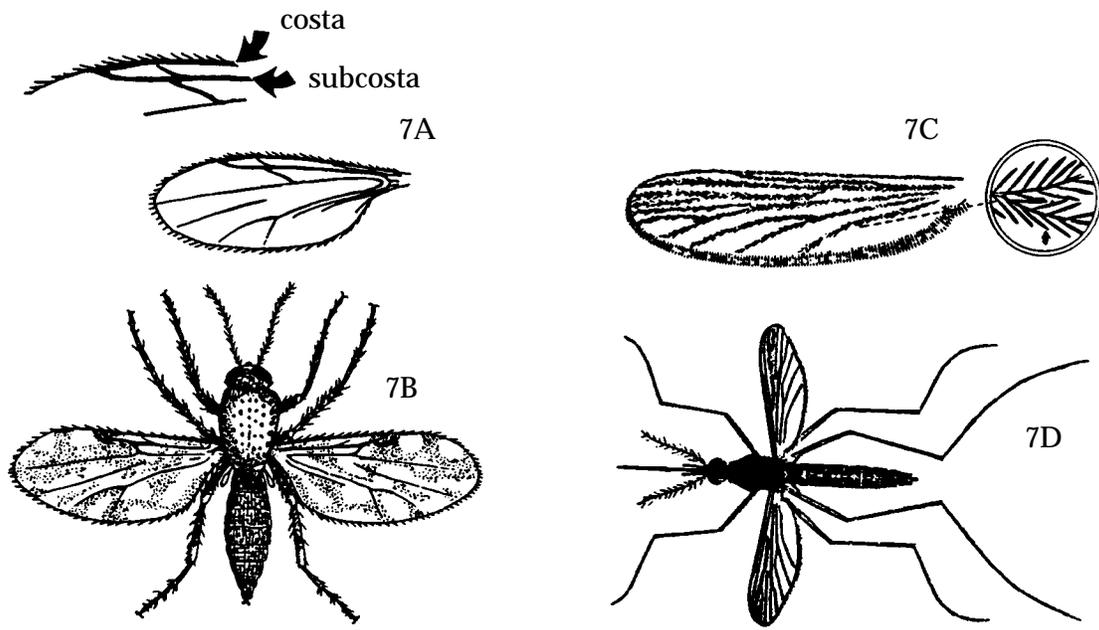
- 4. Antennae (feelers) with 10 or more distinct segments (Fig. 5A) ..... 5
  - Antennae with 3 segments (Fig. 5B) or the apical segments more or less fused (Fig. 5C) ..... 7



5. Short antennae with 10 or 11 segments (Fig. 6A); wing veins slender at rear (Fig. 6B); slightly hump-backed fly 4 mm long or less; bite usually painless at first but later causes swelling and pain ..... BLACK FLY or BUFFALO GNAT
- Longer antennae with 12 to 16 segments (Fig. 6C); wing veins all about the same width (Fig. 6D) ..... 6



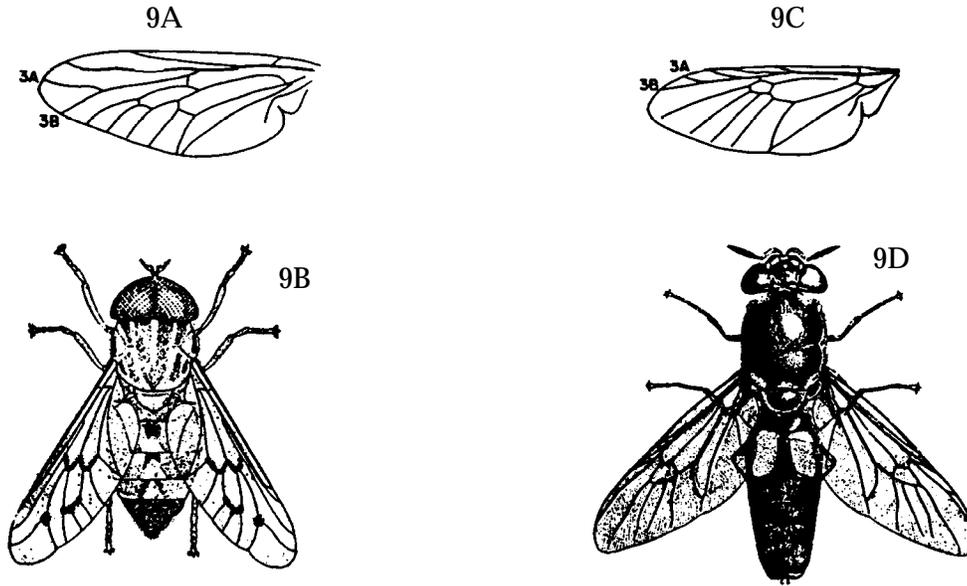
6. Wings not very hairy, costa vein ending before wing tip (Fig. 7A); bloodsucking fly (Fig. 7B) 0.5 to 5.0 mm long ..... BITING MIDGE, PUNKIE, NO-SEE-UM
- Wings scaly and with numerous veins, costa vein continuing around wing tip (Fig. 7C); slender, long-legged fly (Fig. 7D) with wings 3 to 4 mm long; has slender proboscis for sucking blood ..... MOSQUITO



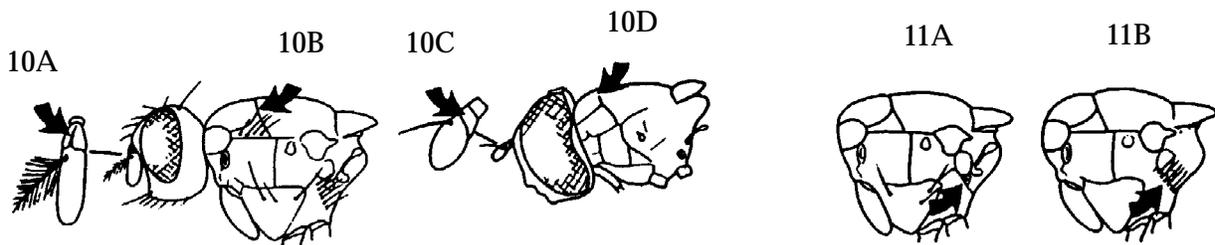
7. Each wing with 4 or 5 cells along rear edge (Fig. 8A) ..... 8
- Each wing with 3 or fewer cells along rear edge (Fig. 8B) ..... 9



8. Third wing vein branched with vein 3A long and vein 3B ending behind wing tip (Fig. 9A); abdomen-flattened; small- to large-bodied fly (Fig. 9B) 10 to 19 mm long; female inflicts painful bite.....HORSE or DEER FLY
- Third wing vein branched with vein 3A short and vein 3B ending before wing tip (Fig. 9C); dusky-winged, nonbiting fly (Fig. 9D) 15 to 20 mm long; wasplike in appearance; bronze or primarily black abdomen ..... BLACK SOLDIER FLY

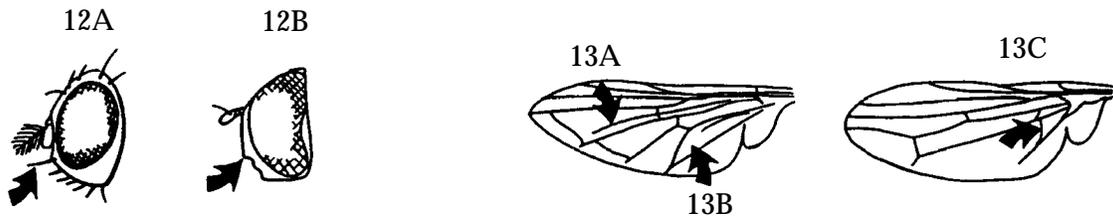


9. Second antennal segment with seam (Fig. 10A); mesonotal suture on thorax goes all the way across (Fig. 10B) ..... 10
- Second antennal segment without seam (Fig. 10C); mesonotal suture absent or note reaching all the way across (Fig. 10D) ..... 11
10. Hypopleura (area just above base of hind legs) bare or with sparse, fine hairs (Fig. 11A) ..... 13
- Hypopleura with row of strong bristles or with long, dense hairs (Fig. 11 B) ..... 19

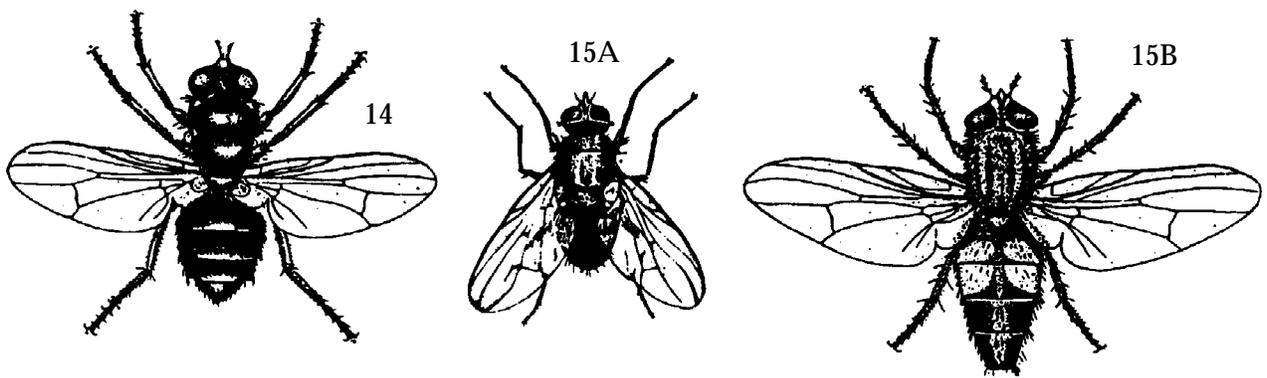


11. Oral vibrissae (hairs near the front of the mouth) usually present (Fig. 12A); nonbiting, gray to black fly only about 1.2 mm long; passes easily through 16-mesh screen ..... EYE GNAT
- Oral vibrissae usually absent (Fig. 12B); fly 15 to 18 mm long ..... 12

12. Spurious (extra) vein present (Fig. 13A) and anal cell nearly reaches wing margin (Fig. 13B); hairy, brownish to black, beelike fly about 15 mm long; has mouthparts but doesn't bite.... DRONE FLY  
 Anal cell short (Fig. 13C); hairy, brownish to reddish fly about 18 mm long; mouthparts absent ..... BOT FLY



13. Slender, shiny black, nonbiting fly (Fig. 14) about 5 mm long ..... GARBAGE or DUMP FLY  
 Fly dull, not shiny ..... 14



14. Fly usually less than 6 mm long ..... 15  
 Fly usually longer than 6 mm ..... 16

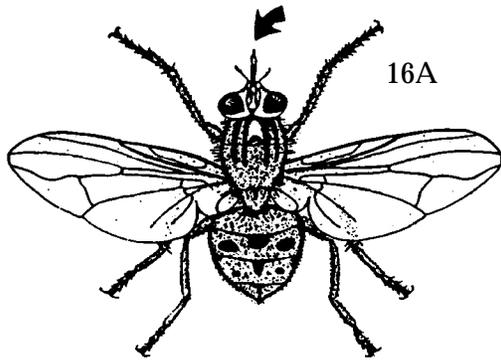
15. Brownish-gray to black with yellowish cast to body; blood-sucking; 3.5 to 4 mm long; set of parallel stripes just behind head (Fig. 15A); brownish-red antennae; usually a pest of cattle and horses ..... HORN FLY

Slender, nonbiting fly 5 to 6 mm long; dark-colored body with or without stripes (Fig. 15B); hovering and jerky pattern of flight ..... LITTLE HOUSE FLY

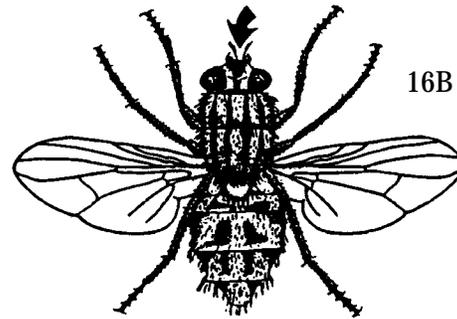
16. Blood-sucking fly with sharp mouthparts which protrude from head (Fig. 16A); body 6 to 8 mm long; 4 dark, longitudinal stripes on thorax; several dark spots on abdomen' "squats" when at rest ..... STABLE FLY

Mouthparts blunt, not protruding (Fig. 16B); nonbiting fly ..... 17

17. Pale spot on top of thorax near abdomen; 4 dark, sometimes indistinct, stripes on thorax; abdomen black or black and red; body about 8 mm long (Fig. 16B) ..... FALSE STABLE FLY  
 Not as above ..... 18

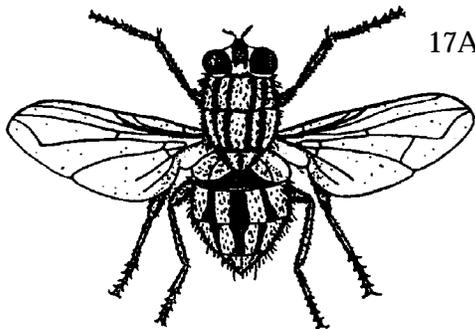


16A



16B

18. Abdomen yellow or partially yellow with dark line down the middle; gray fly (Fig. 17A) about 6.5 mm long with 4 dark, lengthwise stripes on thorax ..... HOUSE FLY  
 Abdomen primarily black with orange base (female) or orange-brown with black base and dorsal stripe (male); thorax gray with 4 dark, lengthwise stripes (Fig. 17B); body 6 to 8 mm long; commonly feeds on moist animal secretions ..... FACE

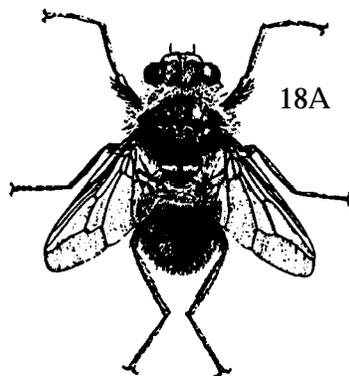


17A

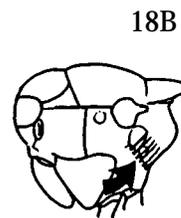


17B

19. Hypopleura (area above base of hind legs) obscured by long, usually dense hairs; mouthparts absent; body about 13 mm long with 2 bands of yellow and white hairs across it (Fig. 18A); reddish-orange hairs at tip of abdomen and on legs; wings dark brown to black ..... CATTLE GRUB FLY  
 Hypopleura with a row of strong bristles (Fig. 18B) ..... 20

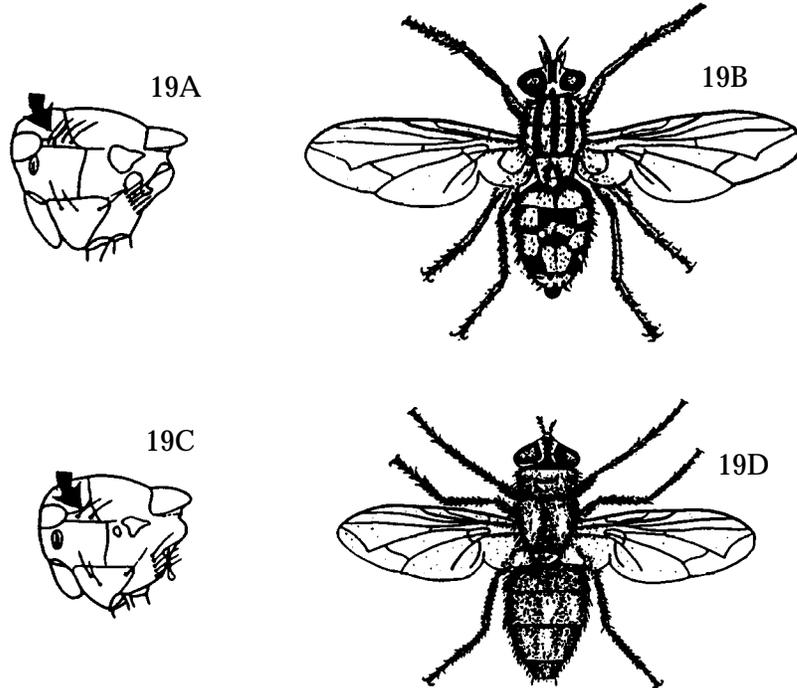


18A

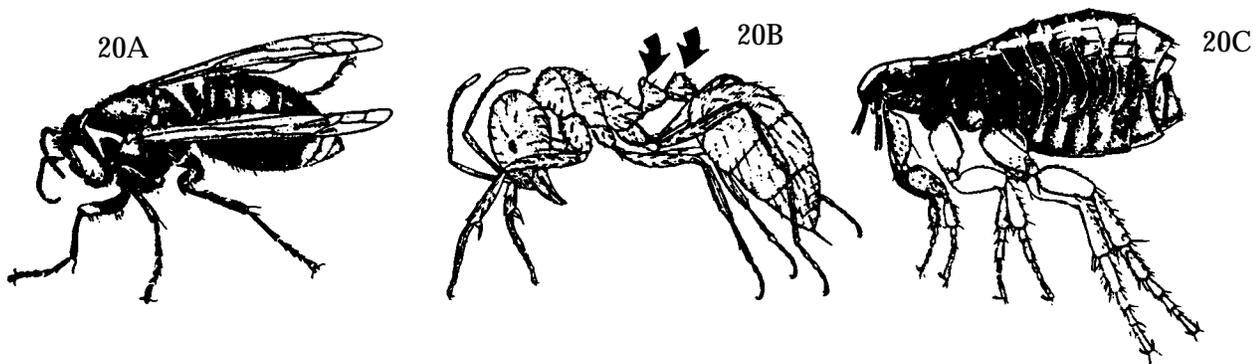


18B

20. Notopleura (“shoulder” of the thorax) usually with 4 bristles (Fig. 19A); gray fly about 10 to 13 mm long; 3 black stripes on thorax; light and dark checkerboard pattern on abdomen (Fig. 19B) ..... FLESH FLY
- Notopleural with only 2 bristles (Fig. 19C); black or metallic-colored fly 6 to 14 mm long; no stripes or checkerboard pattern (Fig. 19D) ..... BLOW FLY

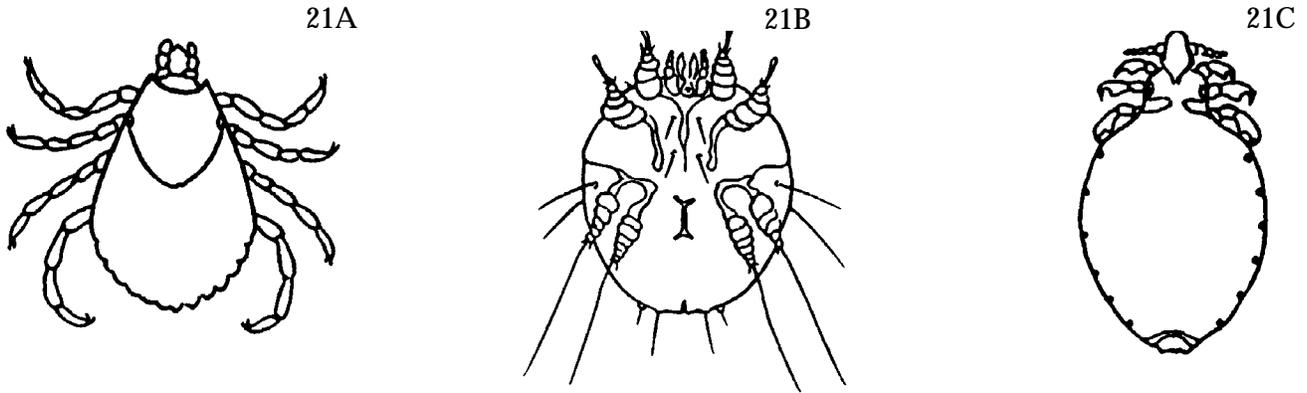


21. Two pairs of wings; constricted “waist” without nodes (bumps); smooth-bodied, stinging insect (fig. 20A) 13 to 25 mm long; color variable; associated with papery nests under or above ground ..... HORNET, WASP, YELLOW JACKET
- No wings; “waist” constricted with nodes (Fig. 20B) or note constricted (Fig. 20C) ..... 22
22. Constricted “waist” with nodes (Fig. 20B); body usually reddish or dark brown and 3 to 6 mm long; stinging ant associated with mounds 35 cm or more in diameter and 20 to 25 cm high ..... FIRE ANT
- No constricted “waist” as above ..... 23



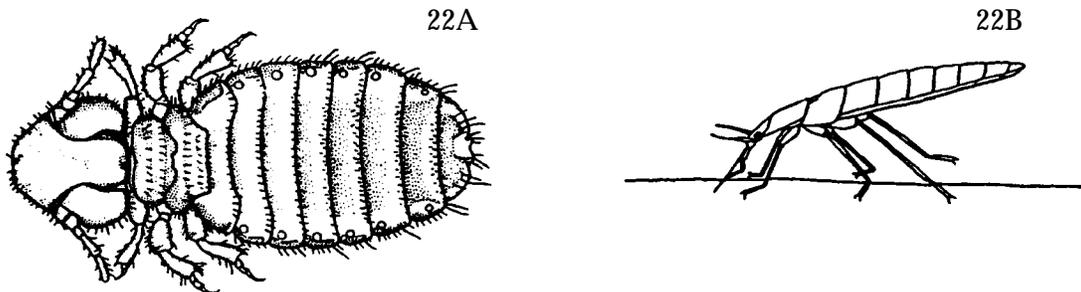
23. Body flattened laterally (from side to side); spiny, hard-skinned insect (Fig. 20C) 1 to 2.5 mm long; hind legs modified for jumping ..... FLEA
- Body not flattened laterally ..... 24

24. Pest 1 mm or less in length; associated with slightly larger, 8-legged animals which are otherwise similar in appearance (Fig. 21A, B) (key out the larger, 8-legged pests) ..... 31  
 No association as above; all animals with 6 legs; size variable; body somewhat flattened dorsoventrally (from top to bottom) (Fig. 21C) ..... 25



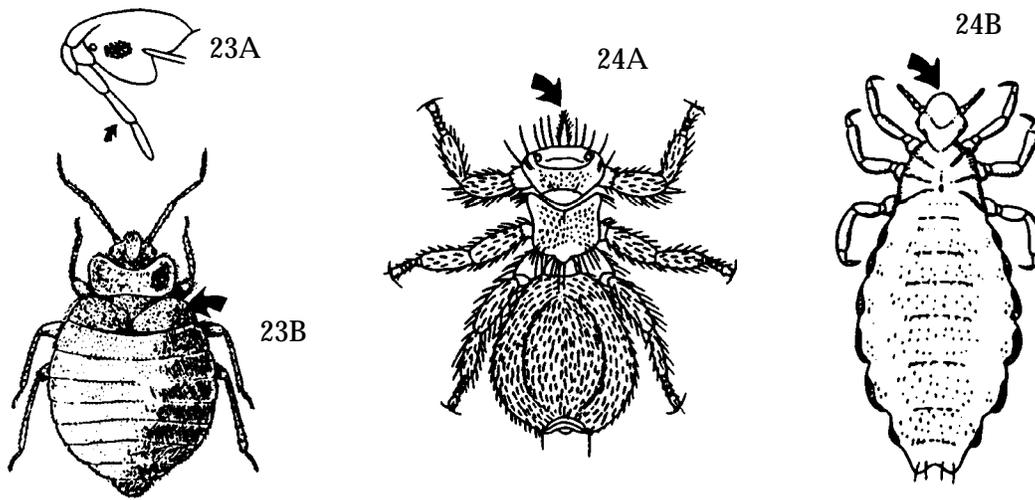
25. Chewing mouthparts; yellowish-white louse with broad, flat, reddish head (Fig. 22A); body up to 1.5 mm long with 8 dark crossbands on abdomen ..... 26  
 Piercing-sucking mouthparts; body somewhat flattened dorsoventrally (from top to bottom) (Fig. 22 B) ..... 27

26. Feeding on cattle ..... CATTLE BITING LOUSE  
 Feeding on skin or feathers of poultry ..... CHICKEN BODY

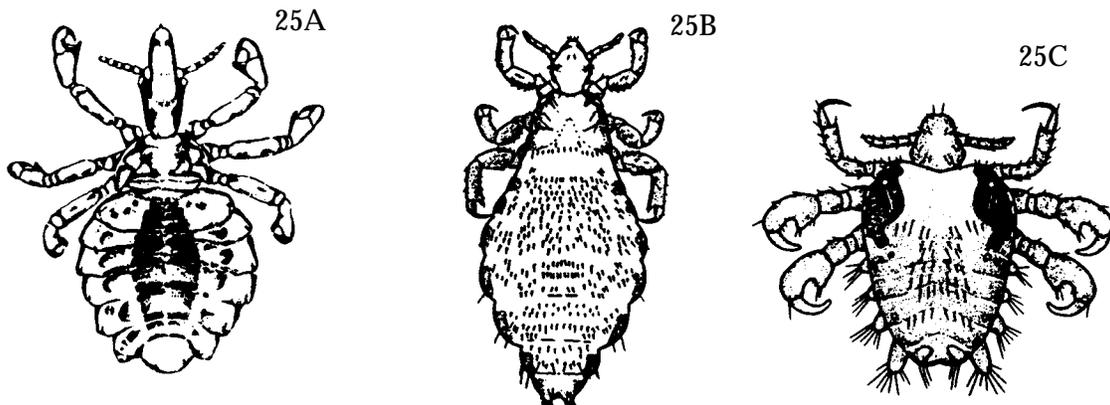


27. Jointed beak (Fig. 23A); reddish-brown, oval, flattened insect up to 9 mm long; small, padlike wing remnants (Fig. 23B); pronotum (just behind head) collarlike ..... BED BUG  
 Beak not jointed, sometimes retracted into head ..... 28

28. Needlelike mouthparts exposed (Fig. 24A); short, thick legs with apical spurs; body about 6 mm long; blood-sucking parasite of sheep ..... SHEEP KED  
 Mouthparts retracted into head; blood-sucking louse (Fig. 24B) ..... 29

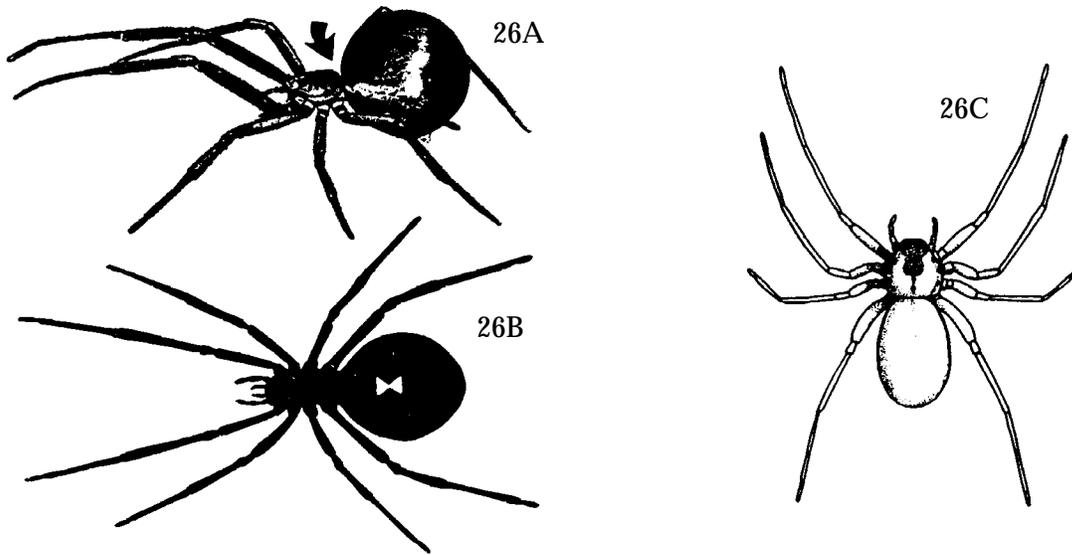


29. Parasite of hogs; oval, grayish-brown louse up to 6 mm long; brown and black markings on body; legs clawlike (Fig. 25A) ..... HOG LOUSE  
 Parasite of man; grayish-white louse 4 mm or less in length ..... 30
30. Abdomen longer than wide; body up to 4 mm long without hairy tubercles (Fig. 25B); all legs about equal in size ..... HEAD and BODY LOUSE  
 Abdomen about as long as wide; body up to 2 mm long with hairy tubercles (Fig. 25C); front pair of legs more slender than other pairs ..... CRAB LOUSE

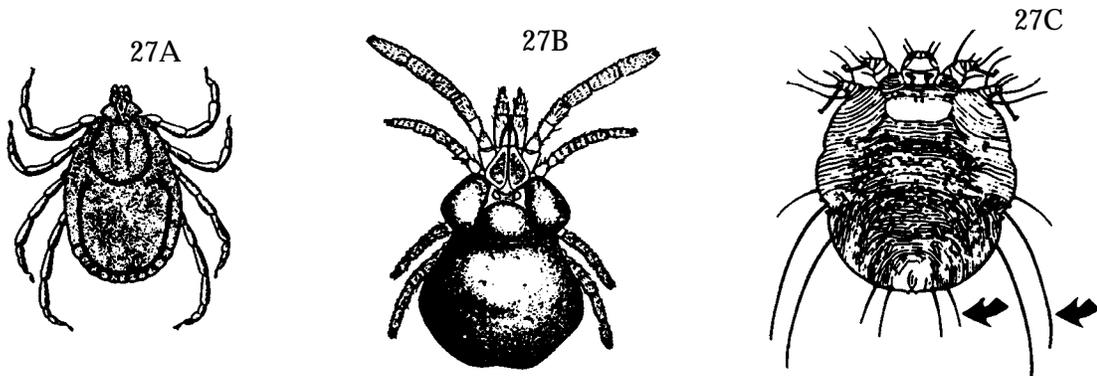


31. Abdomen constricted to form a narrow “waist” (Fig. 26A) ..... 32  
 No constricted “waist” (Fig. 27); bloodsucking parasite of man and animals; some immature stages 6-legged ..... 33

32. Spider with black, globular abdomen about 9 by 13 mm with red or yellow, hourglass marking on underside (Fig. 26A, B) ..... BLACK WIDOW SPIDER  
 Grayish- to reddish-brown spider with black, fiddlelike marking on the head and thorax; body 7 to 13 mm long with a leg span about the size of a half dollar (Fig. 26C) ..... BROWN RECLUSE SPIDER

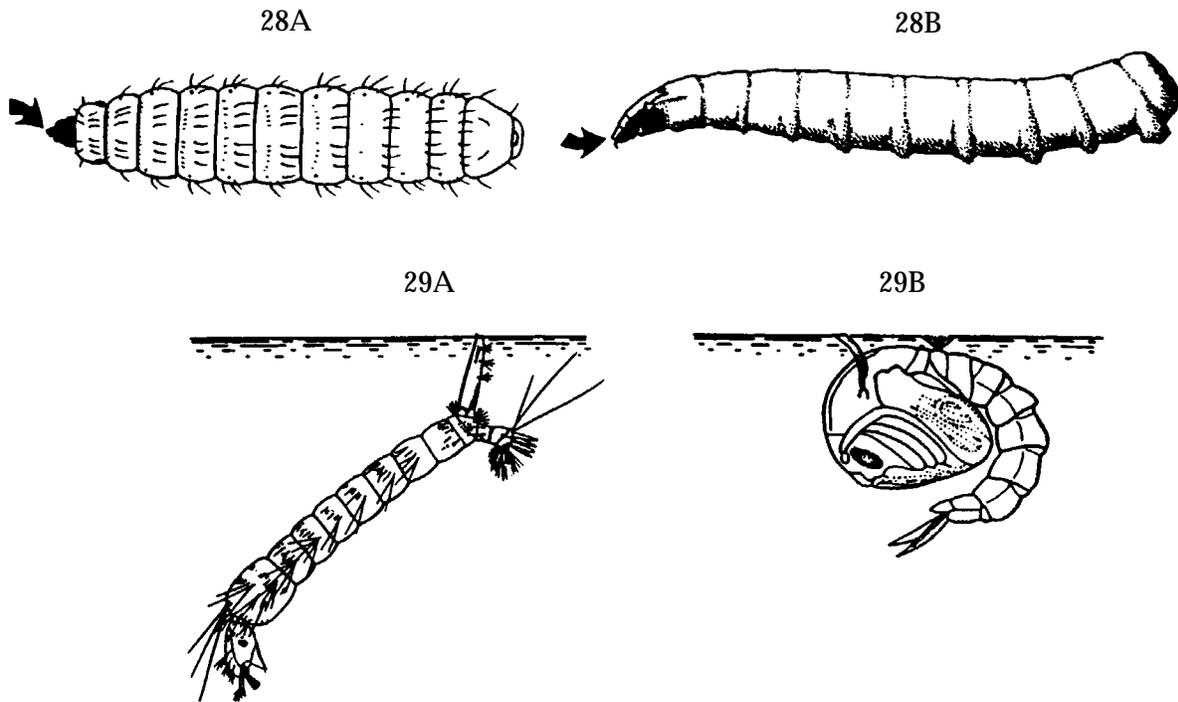


33. Hairless body from 0.5 mm up to 7 mm long (immature to adult) (Fig. 27A); usually brown, reddish brown or gray ..... TICK  
 Body with long or short hairs (Fig. 27B, C); body usually 1.25 mm long or less; color variable ..... CHIGGER or MITE

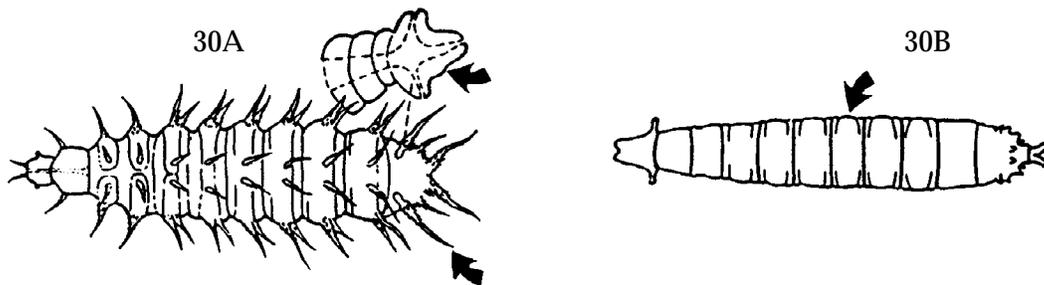


34. With a definite head (Fig. 28A) ..... 35  
 Without a definite head (the mouthparts are tucked into the thorax, Fig. 28B) ..... 36

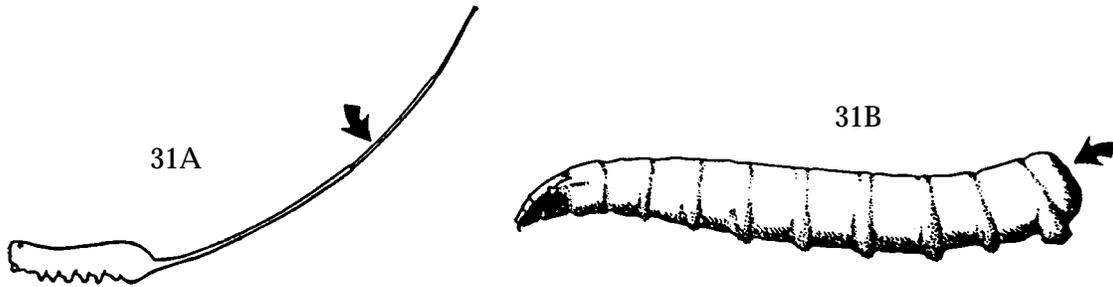
35. Body large and flattened, 12 to 27 mm long when fully grown; creamy white to reddish brown; develops in decaying organic matter (Fig. 28A) ..... BLACK SOLDIER FLY LARVA  
 Slender, aquatic larva up to 10 mm long or curled pupa; transparent to greenish brown; develops in still rather than running water (Fig. 29A and B) ..... MOSQUITO LARVA and/or PUPA



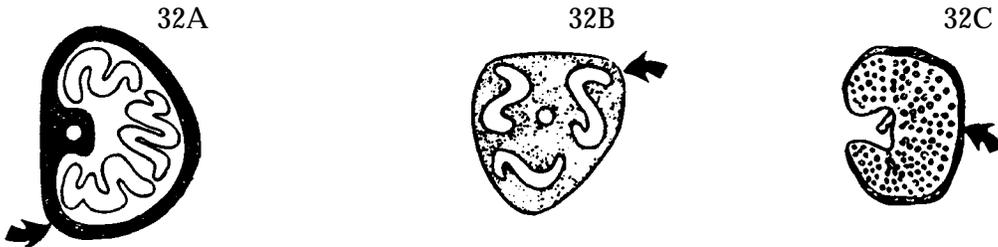
36. Body with pointed projections on each segment (Fig. 30A); posterior spiracles (breathing openings) on small bumps; white to light brown body up to 8 mm long ..... LESSER HOUSE FLY LARVA  
 Body smooth or with short spines; no long pointed projections; posterior spiracles not on bumps (Fig. 30B) ..... 37



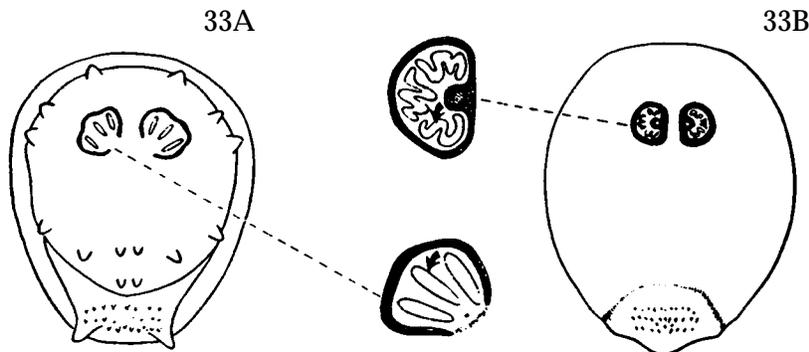
37. Leathery; aquatic; larva up to 20 mm long, with long, taillike breathing tube (Fig. 31A) ..... RAT-TAILED MAGGOT  
 Larva without a taillike process (Fig. 31B) ..... 38



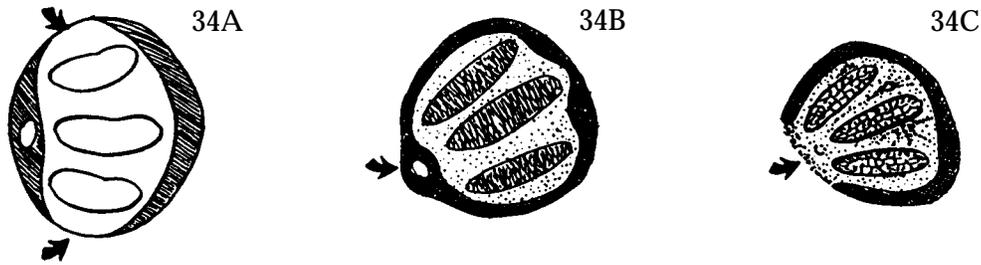
38. Hard, dark line (peritreme) present around hind spiracles; each spiracle with 3 distinct slits (Fig. 32A) ..... 39  
 No peritreme around hind spiracles (Fig. 32B); or, if peritreme present, then 3 slits absent (Fig. 32C) ..... 45



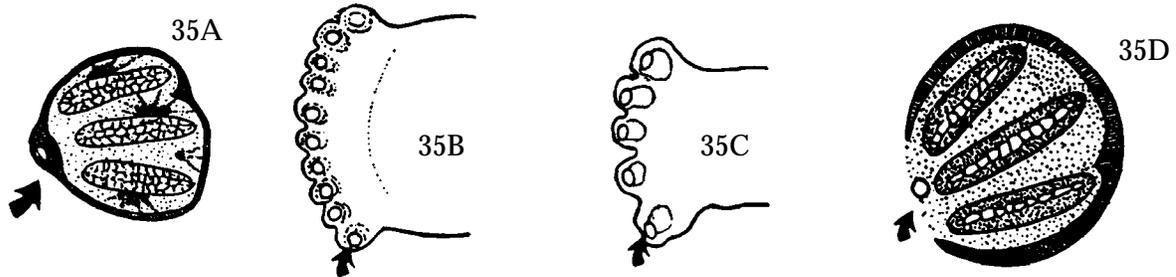
39. Slits of hind spiracles straight (Fig. 33A) ..... 40  
 Slits of hind spiracles strongly curved (Fig. 33B) ..... 44



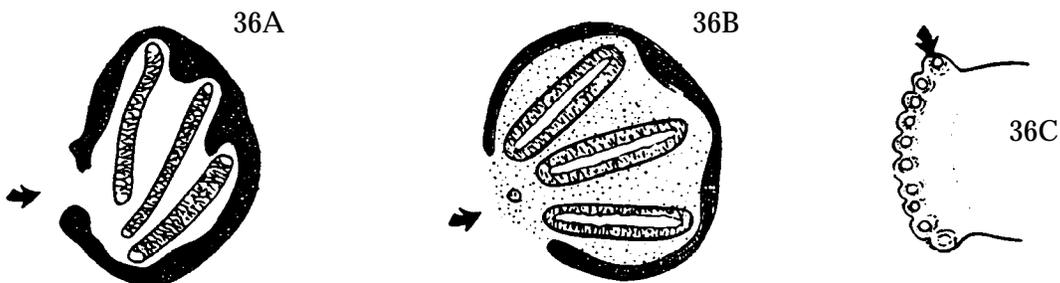
40. Peritreme of hind spiracle very thin on top and bottom (Fig. 34A); spiracles slightly elevated and, when viewed from rear, slanted toward each other; hardened, spiny larva at least 10 mm long when fully grown; develops in decaying organic matter ..... BLACK GARBAGE or DUMP FLY LARVA  
 Peritreme complete (Fig., 34B) or with only lower portion missing (Fig. 34C) ..... 41



41. Hind spiracles with peritreme complete (Fig. 35A); at least one of the two prothoracic spiracles (close to front end) with 8 or more openings (Fig. 35B, a green bottle fly) or prothoracic spiracles with 6 or less openings (Fig. 35C, a bronze bottle fly); yellowish to white maggot up to 14 mm long; develops in decaying organic matter, sometimes carrion or animal wounds ..... BOTTLE FLY LARVA  
 Hind spiracles with peritreme incomplete, not enclosing a "button," (the "button" is a tiny, round pale area which is sometimes hard to see, Fig. 35D) ..... 42



42. Slits of hind spiracle not pointing toward opening in peritreme (Fig. 36A); white to yellowish maggot 10 to 22 mm long when fully grown; develops in wounds, carrion or excrement .... FLESH FLY LARVA  
 Slits of hind spiracle pointing toward opening in peritreme (Fig. 36B); at least one of the prothoracic spiracles (close to front end) with 10 or more openings (Fig. 36C) ..... 43

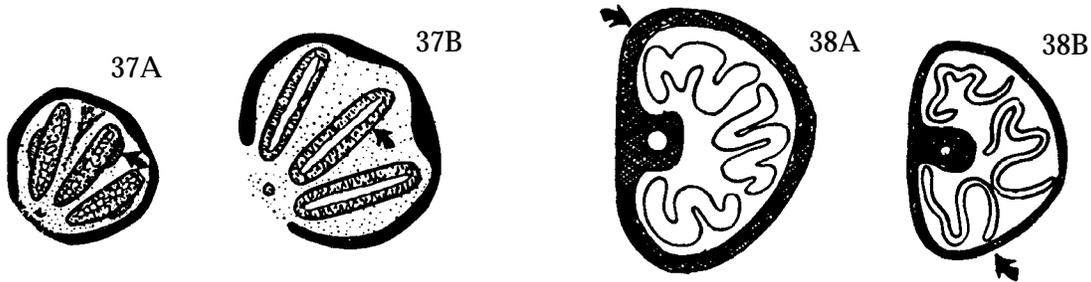


43. Hind spiracle with button distinct or absent, walls of slits with lateral swellings (Fig. 37A); white or yellowish maggot up to 18 mm long; develops only on dead animal tissues ..... SECONDARY SCREWORM

Hind spiracle with button present, walls of slits without lateral swellings (Fig. 37B); white or yellowish maggot up to 17 mm long; develops in decaying organic matter, carrion or animal wounds.  
..... BLACK BLOW FLY LARVA

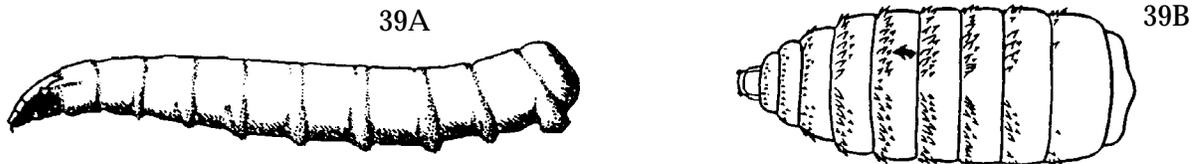
44. Peritreme of hind spiracle thick (Fig. 38A); nearly white maggot up to 13 mm long; common in moist feces and decaying organic matter ..... HOUSE FLY LARVA

Peritreme of hind spiracle thin (Fig. 38B); white maggot 6.5 to 7.5 mm long when fully grown; common in fresh bovine feces ..... HORN FLY LARVA



45. Small or slender, maggot-type larva usually, but not always, less than 13 mm long, tapering toward the head (Fig. 39A); develops in decaying organic matter ..... 46

Large, robust larva with very stout spines (Fig. 39B); over 15 mm long when fully grown; internal parasite of animals ..... 48

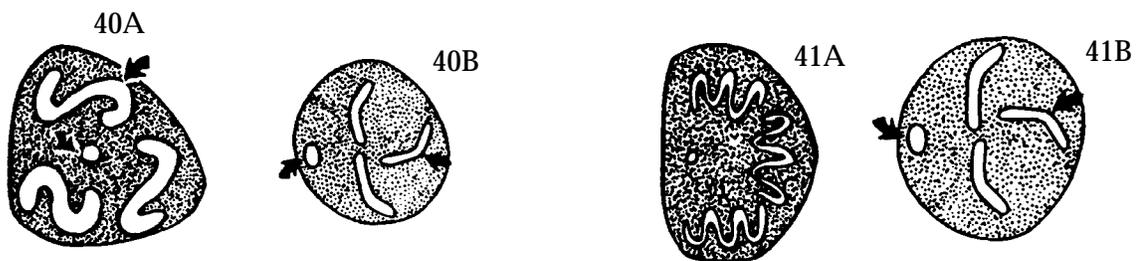


46. Button of hind spiracle centrally located (Fig. 40A); creamy white to pale yellow maggot up to 12 mm long; develops in moist, decomposing organic matter (usually not in manure piles) ..... STABLE FLY LARVA

Button of hind spiracle not centrally located (Fig. 40B) ..... 47

47. Slits of hind spiracles strongly curved (Fig. 41A); yellowish maggot up to 13 mm long; develops in fresh bovine manure ..... FACE FLY LARVA

Slits of hind spiracles not strongly curved (Fig. 41B); grayish to cream-colored larva 12 to 18 mm long when fully grown; develops in decaying organic matter, including manure ..... FALSE STABLE FLY LARVA

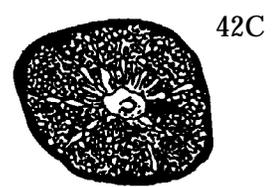
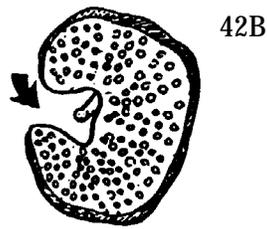


48. Hind spiracles with 3 distinct, slightly curved slits (Fig. 42A); yellowish- to dirty-white larva 17 to 24 mm long when fully grown; spines dark brown; internal parasite of horses ..... HORSE BOT FLY LARVA

Hind spiracle without 3 distinct slits ..... 49

49. Button of hind spiracle not centrally located or enclosed; opening toward button wide (Fig. 42B); white when young; mature larva black, up to 28 mm long and 13 mm wide; subcutaneous along back line of cattle ..... COMMON CATTLE GRUB

Button of hind spiracle enclosed, centrally located (Fig. 42C); larva more than 15 mm long when mature; body with stout spines ..... SHEEP BOT FLY



---

# CHAPTER 3

## PESTICIDES

### LEARNING OBJECTIVES:

After you complete your study of this chapter, you should be able to:

- Explain four methods for classifying pesticides.
- Understand the difference between contact and systemic pesticides and how they control pests.
- Explain what organic and inorganic pesticides are.
- Differentiate between several pesticide chemistries registered for use on animals and the precautions necessary when handling or using them.
- Distinguish between active and inert ingredients.
- Identify the factors to consider when choosing a formulation.
- Explain the various methods of pesticide applications appropriate for small animals and their environment.
- Perform the precautions necessary for safe pesticide applications on an animal or in its environment.
- Recognize symptoms associated with small animal pesticide poisoning.
- Explain how and when pesticides may be incompatible.
- Understand how pesticides can harm nontarget organisms.

---

Pesticides are substances or mixtures of substances intended to prevent, destroy, repel or manage pests. In addition, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) has extended the legal definition of a “pesticide” to include compounds intended for use as plant growth regulators, defoliant or desiccants, even though they are not normally used as pest management agents, and are usually not effective as such.

More specifically a **pesticide** may be defined as any chemical used to control pest populations directly or to prevent or reduce pest damage. Though the ending “cide” is derived from the Latin word *cida*, meaning “to kill,” not all pesticides actually kill the target organism. For example, some fungicides may simply inhibit the growth of a fungus without killing it; attractants and repellents lure a pest to or divert it from a particular site.

The following chapters discuss a wide variety of insects, mites and ticks that afflict companion animals. Activities or infestations by these pests can, in many cases, severely compromise the health and well-being of individual animals.

Though insecticides (control insects) and acaricides (control arachnids) are not the only means for controlling or preventing these pests from becoming problems, they often play an important or even a key role. Sometimes, one must choose between insecticide applications and drug treatments to deal with insect pests that are true parasites.

Pesticides are a mixed blessing. For example, they contribute significantly to agricultural productivity and to improved public health by managing disease-carrying pests, but they can adversely affect people, nontarget organisms such as fish and wildlife, and the environment.

Before using insecticides, one should think about the components of an integrated pest management program (see Chapter 2). For insect, mite or tick pests of animals, this means developing management systems that employ the full range of physical and cultural methods available to manage the pests before insecticides are used. For example, in the case of filth fly problems in kennels or pet exercise areas, insecticides should not be used until good sanitation practices have been

established. Also, purchasing pets from reputable breeders is a cultural preventive measure that may mean lice and mange mites can be avoided or kept in check.

In another example, flea control for pet dogs or cats must include sanitation and control around the home to eliminate larval fleas and flea eggs. Fleas do occur in very clean houses, but sanitation is essential for a successful flea management program. Attaching flea collars or medallions to pets during seasons of high flea pressure may help reduce the chance of new infestations. Check the animal frequently, especially after it has been at a boarding or grooming facility or veterinarian's office. Other animals at these locations may spread fleas to non-infested animals. Typically, only after an infestation occurs should you consider insecticide use in the home or on the pet, and then only in conjunction with good sanitation practices. The exception may be when a pet has flea bite sensitivity. Treatment after a flea population has become established would be too late to avoid the animal's discomfort. In this case, insect growth inhibitor products may be effectively used to prevent a problem from becoming established.

In this chapter, you will learn how pesticides are classified, the types of formulations, application methods, basic concepts of pest control on animals, and special concerns with pesticide use on and around animals. This knowledge will help you to use pesticides safely and effectively.

## PESTICIDE CLASSIFICATIONS

Pesticides are classified according to a number of methods. Each method serves specific purposes. The four most common methods of classifying pesticides are based on (1) the group of pests managed by the pesticide, (2) how the pesticide works, (3) the chemical nature of the pesticide, and (4) the pesticide formulation.

### Method 1: Types of Pests Managed

This pesticide grouping system is as follows:

Pesticide Classification	Pests Managed
Insecticide	Insects and other related animals
Acaricide	Mites, ticks and spiders
Miticide	Mites
Fungicide	Fungi
Herbicide	Weeds
Rodenticide	Rodents
Avicide	Birds
Piscicide	Fish
Ovicide	Eggs of organisms

### Method 2: How Pesticides Work

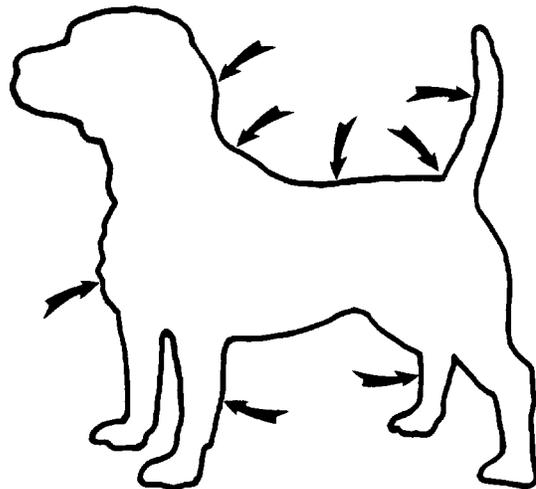
These common terms classify pesticides based on how they work:

**Protectants** – Pesticides applied to plants, animals, structures and products to prevent pest establishment. These may include repellents.

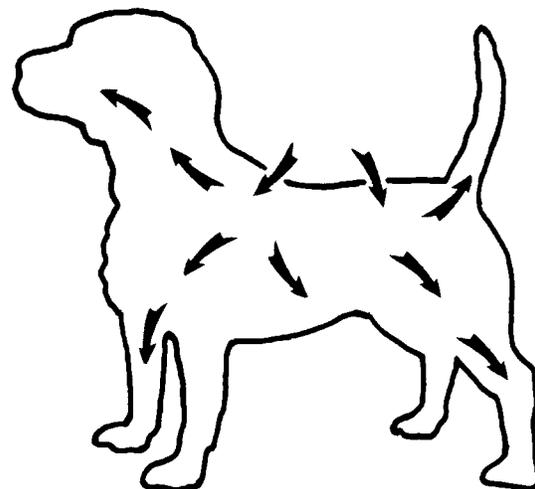
**Sterilants** – Pesticides that manage pests by rendering them incapable of normal reproduction.

**Broad-spectrums** – Pesticides that control two or more pests. They are sometimes labeled as multi-purpose chemicals. A material capable of controlling fleas and ticks for, example, is broad spectrum. This category of pesticides is somewhat more general than the others because a broad spectrum pesticide may be a protectant, an eradicator or a systemic in its action.

**Contacts** – Pesticides that kill pests simply by coming into contact with them.



Contact



Systemic

**Systemics** – Pesticides that are absorbed by one part of the animal or plant and distributed internally to other parts of the plant or animal. For example, some flea control agents are given orally to dogs. The flea is killed when it bites the dog and ingests the insecticide.

Many synthetic organic pesticides work in one or more of the ways listed above. Read the pesticide label to find out how the pesticide you are using works.

### Method 3: Pesticide Chemistry

Pesticides can be divided into two chemical groups: inorganic and organic compounds.

**Inorganic pesticides** are of mineral origin and therefore do not contain carbon. They commonly contain either copper, boron, sulfur or zinc. Examples are lime-sulfur and Bordeaux mix. Inorganic pesticides are used primarily to manage plant diseases or for controlling certain pests on young, pregnant or stressed animals. Examples are given in later chapters.

**Organic pesticides** contain carbon. They also contain hydrogen and often oxygen, nitrogen, phosphorus, sulfur or other elements. Most pesticides in use today are organic compounds. Most are synthetic or manmade compounds. These compounds have been primarily responsible for the rapidly expanding use of pesticides since the 1940s. They are often extremely effective and easy to use, they have been relatively inexpensive, and some are quite specific in their activity. They have, however, been the principal focus of health and environmental concerns and have been primarily responsible for problems associated with pesticide use and misuse.

The **synthetic organic pesticides** (i.e., man-made, carbon-containing chemicals) include the chlorinated hydrocarbons, organophosphates, carbamates, synthetic pyrethroids, phenoxy herbicides and a number of other chemical classes.

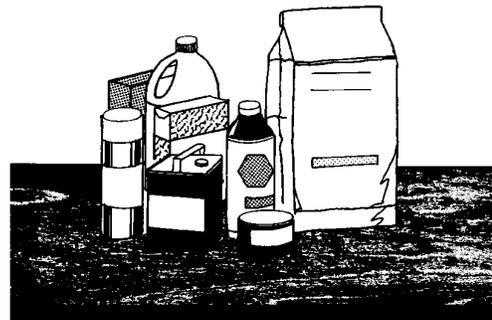
Several types of insecticides and acaricides are used to control pests on or around animals. Classes of drugs used for pest control on animals are not reviewed in this manual. A drug is a treatment chemical approved and regulated by the Food and Drug Administration and is not classified by the EPA as a pesticide. Certain drugs and insecticides may control the same pest, however.

Under present regulations, pesticide labels must carry warnings against use of many compounds on certain animals or under certain circumstances. These warnings may pertain to acute or chronic toxicity or to residues in livestock animals. Label changes may arise from state or fed-

eral legislative action, changes in executive interpretation or changing ecological interests, so it is critical to read and follow current label directions every time a product is used.

### Method 4: Pesticide Formulations

The component of a pesticide that controls the target pest is called the **active ingredient** (a.i.). Before a pesticide product is sold, active ingredients are mixed with liquid or dry **inert ingredients** (non-pesticidal). Though inert ingredients do not kill the target pest, they may be capable of causing adverse environmental and human health effects. Mixtures of active and inert ingredients are called **pesticide formulations**. Formulations make an active ingredient more convenient to handle; safer and easier to apply more accurately; and in some cases, more attractive to the pest.



## Classes of Insecticides/acaricides Used in Animal Pest Management:

Eleven chemical classes of insecticides and acaricides are used to control pests on or around animals.

1. **Chlorinated hydrocarbons.** This class includes lindane and methoxychlor. Lindane has become a restricted use pesticide for mange mites and lice.

Chlorinated hydrocarbons are easily absorbed through the skin and accumulate in the body. Overexposure can occur from excessive use. These products are not recommended for cats and, several feline poisonings have occurred. Common symptoms of companion animal chlorinated hydrocarbon poisoning may include seizures, salivation, vomiting, tremors and death.

2. **Organophosphates (OP).** An organophosphate is a synthetic organic pesticide containing carbon, hydrogen and phosphorus. If the product label bears chemical names containing “phosphoro” and recommendations to use atropine plus

pralidoxime (2-PAM) as an antidote for poisoning, you can assume the product is an OP insecticide. Organophosphate compounds inhibit cholinesterase (see Chapter 5, Pesticides and Human Health). Cholinesterase is a chemical catalyst (enzyme) found in mammals that helps regulate the activity of nerve impulses.

This class of pesticides includes a broad range of insecticides/acaricides such as chlorpyrifos, malathion, DDVP, ronnel, stiriphos and others. Organophosphates are effective against a wide range of insects including fleas and ticks. OPs are commercially available as ready-to-use insecticidal solutions, emulsifiable concentrates, dips, dusts, baits and flea collars.

These products range from acutely to mildly toxic to animals. The body has the ability to break these compounds down, usually in the first 24 hours. Though they are less likely to accumulate in the body than chlorinated hydrocarbons, organophosphates cannot be used in conjunction with one another because they can accumulate during a short period of time immediately following exposure. Find out whether the animal has been administered an oral, systemic OP. If so, do not treat with a topically applied OP. The two products can have a combined effect on cholinesterase activity.

Overexposure to OPs commonly causes such symptoms as tremors, vomiting, salivation, **ataxia** (inability to coordinate voluntary muscular movements), loss of appetite, diarrhea, seizures, breathing difficulty (**dyspnea**), weakness and death.

A large percentage of serious OP poisonings have been related to the more toxic dip solutions dispensed by veterinarians. Major problems commonly result when canine products are used on cats. Deaths associated with chlorpyrifos poisonings have also been attributed to dip solutions. Cats topically exposed to chlorpyrifos may have delayed signs of poisoning, and these symptoms may persist for weeks. Abnormal behavior and loss of appetite may be most noticeable.

The third most commonly reported organophosphate insecticide-related poisoning among all animal types has been dichlorvos (DDVP). Many foggers contain DDVP in combination with other cholinesterase-inhibiting insecticides. DDVP-based flea collars have been involved with poisonings, especially in cats. Reading product labels and following all precautions and directions for use greatly reduces the chance of poisonings.

Onset of symptoms after excessive OP exposure usually occurs within hours but may be delayed up to two days. Severity and development of

symptoms are influenced by the dosage and the route of exposure (dermal, oral, etc.). If poisoning from an OP is suspected, obtain immediate assistance from a veterinarian and take the label of the suspect insecticide with you.

**3. Carbamates.** Carbamates are similar to organophosphates in activity—they inhibit cholinesterase. Carbaryl, propoxur and methomyl are carbamates. Small animals have been the victims of carbamate poisoning by products labeled for use on sites other than on the animal. These include ant traps, products used for home insect control and agricultural products. Methomyl is particularly hazardous to dogs and cats because of its inherent toxicity (LD50 of 17 mg/kg) and the apparent palatability of the sugar baits in which it is often formulated.

Carbamate poisoning is characterized by excessive salivation, tremors, vomiting, seizures, diarrhea and loss of muscle control. If you suspect carbamate poisoning, obtain immediate assistance from a veterinarian and take the label of the suspect insecticide with you.

**4. Synthetic pyrethroids.** This class of insecticides/acaricides includes permethrin, resmethrin and allethrin. Often the formulations contain a **synergist** (something that enhances the effectiveness of the active ingredient) called piperonyl butoxide, or PBO. By itself, PBO is relatively nontoxic. The synthetic pyrethroids show properties of low mammalian toxicity but good activity against insects, ticks and mites. They do not appear to be readily absorbed through the skin.

Animals mildly affected by pyrethroids and those in the early stages of pyrethroid poisoning often display hypersalivation, vomiting, diarrhea, mild tremors, hyperexcitability or depression. These symptoms may be confused with symptoms of organophosphate or carbamate poisoning. More severely affected animals can have high fevers or lowered body temperature, difficulty breathing, severe tremors, disorientation and seizures. Death is due to respiratory failure. Generally, these signs begin within a few hours of exposure. In the case of excessive dermal exposure, the animal should be bathed using mild detergent and rinsed repeatedly. Initial assessment of the animal's respiratory and cardiovascular condition is important. Further treatment requires veterinarian assistance.

**5. Botanicals.** Rotenone and pyrethrin are derived from plants. They may be synergized in certain formulations with PBO. With the exception of nicotine, plant-derived insecticides have shown low mammalian toxicity.

6. **Repellents.** Repellents, though not strictly insecticides, help prevent animal pest establishment. Diethyl-meta-toluamide (DEET), butoxy-polypropylene glycol and dipropyl isocinchomeronate are repellents with activity against certain arthropods. Some formulations containing synthetic pyrethroids are repellents. There have been reported deaths of both cats and dogs after excessive exposure to DEET. The most common signs of poisoning include vomiting, tremors, ataxia and incoordination, hyperactivity, hypersalivation, depression, loss of appetite, seizures and breathing difficulty.

7. **Lime sulfur** (calcium polysulfide). Sulfur and lime-sulfur are two of the oldest insecticides. Lime-sulfur is an inorganic chemical option for lice control. Lime-sulfur may cause the animal irritation, discomfort or blistering, but it rarely causes death. If overexposure is suspected, bathe the animal to remove any residues and rinse repeatedly with clean water.

8. **Mineral oil.** Mineral oil is useful as a barrier against biting flies in ears of horses. It is also a diluent in some ear mite treatments that contain carbaryl.

9. **Amitraz.** Amitraz is a formamidine chemical with insecticidal and acaricidal properties.

10. **Insect growth regulators and hormone mimics.** This class of insecticides prevents development of immature insects to the adult stage. Methoprene is formulated as a spray for flea control (eggs on animals, larvae in the environment). These chemicals simulate the activity of juvenile hormone, the hormone in insects that maintains immature characteristics in insects.

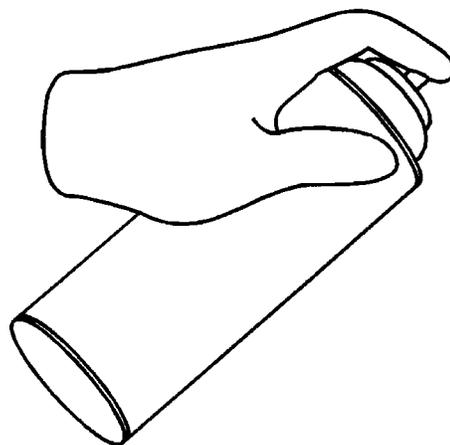
11. **Ivermectins.** The ivermectin/avermectin group of insecticides are labeled as drugs, and they often come into use for pest control on animals. Because they are drugs, they must be obtained and administered by a veterinarian for companion animal use.

## FORMULATIONS USED IN MANAGING SMALL ANIMAL PESTS

It is important to choose the formulation that is best for a particular job based on its effectiveness, cost, practicality, and relative safety to you, the animal being treated and the environment.

Insecticide and acaricide formulations vary widely and must be chosen to fit the particular situation. A high-pressure hydraulic sprayer would be inappropriate for applying a flea shampoo to a puppy, to give one extreme example. Under certain conditions, the application method requires a particular formulation. Sometimes the formulation and application method are described by the same word (e.g., shampoo). Formulations used for small animal pest management include:

1. **Ready to use (RTU).** Ready-to-use formulations require no mixing or combining with other ingredients or diluents. They usually come in a container that serves as the application device, such as an aerosol can, pour-on bottle, roll-on, spot-on or spray bottle. These formulations tend to be the most expensive options because they are convenient and packaged for application. These may include ointments or gels that help prevent fly bites.



2. **Wettable powders.** Wettable powders must be mixed with water before application. They are concentrates in solid, powdered form. They can be sprayed after mixing.

3. **Emulsifiable concentrates.** Emulsifiable concentrates are liquids that must be mixed with water before application. They can be sprayed after mixing or sponged on the animal.

4. **Shampoo.** A shampoo is a formulation of insecticide and other ingredients that is applied to an animal's wet fur and worked into a lather. Label directions may indicate a length of time that the shampoo must remain on the animal to

achieve effective pest control before being thoroughly rinsed off. Shampoos should be pH balanced and labeled for use on the pet to be treated. Industrial shampoos and dish detergents are not acceptable products for use on small animals. Exercise all caution when applying pesticide products to debilitated animals (animals weakened by injury, illness or some other stress). These animals should be referred to a veterinarian for close observation during and after application.



Insecticides for treating pests on animals are often formulated as shampoos.

5. **Dust.** A dust is a ready-to-use dry formulation. Protect the animal's eyes from the dust. Applicators must wear appropriate personal protective equipment to protect exposed skin, the respiratory tract and eyes.

6. **Feed additive or bolus.** These formulations are mixed with feed or, in the case of a bolus, fed directly to an animal. Proban® is an FDA-regulated product available for companion animal use in a pill or liquid form. If a client is administering an oral formulation, be sure the shampoo or product you select to use is compatible.

7. **Collars and medallions.** Some insecticides and acaricides are formulated with plastics, such as collars and medallions that are fixed to an animal and left attached for a period of time. Collars and

medallions are used on small animals to control fleas and ticks. Plastic straps containing an insecticide can be fixed to horse halters for biting fly control. In these formulations, the insecticide moves from the plastic to the hair or coat of the animal.

8. **Pastes, liquids, powders and tablets/pellets.** These formulations are given orally to animals to control internal parasites. Some products have restrictions, are regulated as drugs by the FDA, and may be purchased and administered only by licensed veterinarians.

9. **Baits.** Baits are either commercially prepared as dry granules or made as mixes of insecticides, sweeteners and water, as discussed in "Methods of Application" below.

## METHODS OF APPLICATION

The methods of application of insecticides/acaricides to animals or the animals' environment depend on the target pest, the formulation chosen and the number of animals or size of area to be treated. Sometimes the limiting factor will be the availability of application equipment or suitable facilities and helpers. Applicators must wear all the protective equipment required on the pesticide label. Labels list minimum requirements. The applicator should use common sense and protect body areas that may be at risk of exposure. Waterproof aprons, gloves, boots and goggles are always a wise choice, especially when bathing animals.



Always wear the appropriate personal protection equipment when making a pesticide application.

A **premise spray** is an insecticide application that will persist on the surfaces in an animal's living area for a period of time. Pest insects, such as filth flies or fleas, will contact these surfaces, encounter the insecticide and die. The spray is intended to offer a few days to a few weeks of control.

An **area spray** or **space spray** does not involve an insecticide with long residual qualities. Instead, the spray, aerosol or fog kills the insects in the area at the time of the application. Thus, a space spray is much more temporary than a premise spray. A space spray may involve **ultra-low volume** equipment—small droplets of insecticide are sprayed at a low rate of application into the space.

An insecticidal **bait** can be purchased ready to use (generally dry, as granules) or can be mixed. Baits can be established at bait stations that lure the pest toward the insecticide source. Some fly baits contain attractants to draw flies in, such as muscamone. Some fly baits are made by mixing sugar, corn syrup or molasses with water and insecticide, and then applied as a slurry with a brush to surfaces in confined settings. Caution: Do not apply this sweet mixture where animals can lick it from treated surfaces.

**Dips** are another method of insecticide application to animals. "Dip" is often the term used to describe the shampoo procedure performed on companion pets in kennels, grooming salons and in veterinary clinics. These situations do not require that the animal be immersed, nor does the animal stand in treated water. Dips may also be pour-on products that do not require total immersion of the animal.

The person bathing or dipping the animal should wear a water- and chemicalproof apron and gloves. As noted in Chapter 5, Pesticides and Human Health, a human's groin area is the most absorptive part of the body and should be completely protected from pesticide exposure. Goggles will prevent splashing water from entering the eyes. **Always wear** the minimum amount of personal protective equipment required on the label. It's OK to wear more.

**Pour-ons** and **spot-ons** are high-concentrate, low-volume formulations applied directly to animals. The materials are applied with the container they are purchased in. Because of the toxicity of the products, spot-ons are typically applied by a veterinarian. These products may require that after being applied, the animal be completely dried before it contacts humans or other animals. Wipes are also used as direct applications to animals—cloths or sponges are saturated with the pesticide

and used to wipe the animal. Wipes are not commonly used for small animal treatments.

Animals can be **dusted** with the use of the shaker in which the product is packaged. The eyes of the animal and the applicator should be protected from dusts.

**Collars and medallions**, though technically formulations as described above, are also methods of application. These formulations come ready to use and are applied by fastening them to the animal. They offer long-term release of insecticide or acaricide onto the animal.

**Feeding insecticides to animals** can be accomplished with drugs prescribed by or obtained from veterinarians. Of course, only those insecticides labeled for oral delivery can be provided in this manner. In other cases, every attempt should be made to avoid contaminating water and feed with insecticides.

## PESTICIDE USE AROUND ANIMALS

Pesticide use on animals or in their environment must be done with the safety of the animals and the applicator in mind. Remember that insecticides and acaricides are toxic not only to the target pest but also to the animals at certain doses. Thus, the dose-response relationship of the insecticide and the targeted animal must be considered. Many insecticides are labeled with restrictions and are not to be used on animals of certain ages (especially young ones), in certain reproductive states (pregnancy, nursing), or on certain breeds. Also, use extreme caution or avoid



Protect the animal's eyes from pesticides by applying an ophthalmic ointment before the pesticide treatment.

using pesticides on animals just before or just after surgery. The product may interact with the anesthesia. Apply all insecticides with extreme care. Insecticides should never be applied to the eyes, nostrils or mouth. When treating dogs and cats for fleas using a spray, the applicator should wear appropriate protective gear and shield his/her eyes and those of the animal. It is standard practice to apply an ophthalmic (eye) ointment to protect a dog or cat's eyes before dipping, spraying or shampooing. Petroleum jellies are not an acceptable substitute for ophthalmic ointment. Be sure not to contaminate ointments. Handle carefully and wash your hands between animal treatments.



Ophthalmic ointment will help prevent pesticide irritation. Extra caution will be necessary when working with animals with flat profiles such as the one on the right.

Source: Canine Terminology

Insecticides must be applied at the rates and with the application methods described on the label. Labels also usually state to avoid testicle and vulva areas and mammary gland areas if the animal is nursing young.

Application of certain insecticides or acaricides on animals is done with the intent of creating a residual of systemic insecticide in the body tissues of the animal. These insecticides are used in ways that do not differ greatly from the way drugs are used for animal health. In such cases, there may be dose limits established in relation to the weight of the animal. Thus, only a certain amount of insecticide per unit of body weight can be applied at any one time.

Many kinds of pesticides are commercially available. Though different products may have the same active ingredient, the formulations can vary significantly. The result may be that one product is safe for animal applications and others are deadly. **Use only products specifically labeled for use on animals or in animal habitats.** Consult with experts such as veterinarians, licensed veterinary technicians, Extension specialists or product

representatives for help in selecting the best product for your situation. These experts can provide verbal advice and specialized literature to help make your decision and support your action. When selecting an insecticide, the label is a primary source of information. If the label does not allow the use or method of application you intend to use on the animal, then that insecticide formulation cannot be used.

When several product choices are available, consider the type and percent of active ingredient, toxicity, formulation, equipment required to make the application and requirements for retreatment later.

In general, observe the following guidelines for insecticide use on or around animals:

1. Use only products labeled for use on animals or in animal environments.
2. Do not exceed label dosages; measure carefully.
3. Read labels before using and follow all instructions.
4. Provide adequate ventilation while using pesticides.
5. Prevent drift or drainage to adjacent cropland, yards, woodlots, lakes or ponds. (Some insecticides may severely harm fish and wildlife.)
6. Avoid treatment of animals that are sick, overheated or stressed (such as after shipping, surgery or heartworm treatment, or recently weaned).
7. If available, use a dust formulation instead of sprays on outdoor animals on cold winter days.
8. Avoid contaminating feed (feeders and/or feed in storage) and water (including waterers, wells and reservoirs). See Chapter 6, Pesticide Handling, Storage and Disposal.
9. Use all appropriate personal protective equipment during applications of any pesticide.
10. Do not add new insecticides to old, previously used dipping water. Start with fresh water.
11. Do not reuse towels used for drying animals without washing them. Launder towels on the hottest and longest wash cycle, using heavy detergent, between uses.
12. Avoid using pesticides when an animal has been, will be or is anesthetized.
13. Keep records of pesticide applications. See Chapter 1, Laws and Regulations.
14. Always store and dispose of pesticide containers according to label directions.

## COMPATIBILITY of PESTICIDES

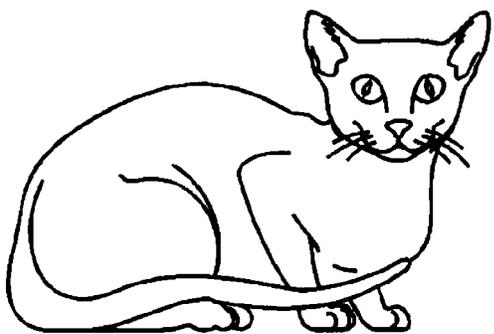
In some situations, applicators may attempt to manage more than one pest with a single application by combining pesticides. Such a practice can create problems, sometimes more serious and costly than applying the chemicals alone. There is no question that product mixing requires extensive knowledge of pesticide formulations, timing of application and application techniques.

The important issue is to determine the compatibility of the products involved. In simple terms, we are concerned about whether the mixtures can be used in combination without reducing the safety and effectiveness of the compounds. Before combining any pesticides, check labels, product information sheets, company representatives or Extension agents for information on compatibility of the products in question.

Below are important areas of incompatibility that you should consider before attempting to mix products.

### Host Tolerance

As mentioned earlier, problems can arise when more than one organophosphate is applied to an animal at any one time, or when a residual is still present from a previously applied dose. Never use more than one OP insecticide on an animal. The combined effects of the OPs may cause irreversible damage to the animal or even kill it. Also, some animals are more sensitive to certain products than others. Always read the label before applying a pesticide on an animal.



Cats are more sensitive to pesticides than most dogs.

### Physical Incompatibility

Physical incompatibility occurs when two or more pesticides are mixed together and the result is an unsprayable mixture because of excessive foaming, curdling or a gummy deposit. Hard water and cold water can also cause some physical incompatibilities.

### Chemical Incompatibility

This type of incompatibility occurs when mixing pesticides reduces or destroys the effectiveness of one or all of the compounds. This happens frequently when materials with a high pH are added to the mixture. Chemical incompatibility is not evident in the spray tank but becomes apparent when the application fails to control the target pest adequately.

### Timing Incompatibility

Pesticides must be applied when the pest is at a vulnerable stage of development. With many insects, diseases or weeds, this may be a relatively short period. It is of utmost importance when using two or more chemicals to manage more than one pest to apply the mixture at the correct time in the pests' life cycles to be effective.

This has been a brief summary of pesticide compatibility problems. Remember, you should never assume that pesticides can be mixed together unless the combination is specifically indicated on a product label. If recommendations for use are not given on the label, the products in the mix must be applied at a rate not to exceed the label directions for use of any component product applied alone for the same purpose. Many product labels have toll-free numbers. Call with any questions you may have before using a product.

## SPECIAL CONCERNS ASSOCIATED WITH PESTICIDE USAGE

Careless pesticide use can create pest resistance and may harm nontarget species. The following sections explain precautions that applicators can take to avoid these problems.

### Pest Resistance

Cross-resistance and multiple resistance to some pesticides (especially insecticides) are becoming common. Cross-resistance occurs when a pest develops resistance to two or more compounds that are usually chemically related with similar modes of action. (Mode of action refers to the chemical's means of exerting a toxic effect.) Multiple resistance occurs when a pest can tolerate pesticides from different classes of compounds with unlike modes of action. Some flea populations have shown resistance to various insecticides.

The possible solutions to a resistance problem may involve using new or altered pesticides,

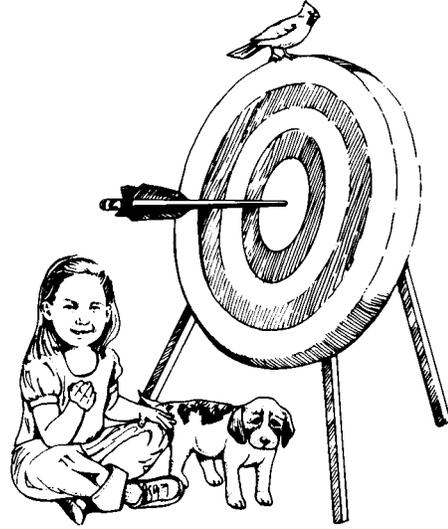
changing pesticide use patterns and, when treating an area repeatedly, alternating the type of insecticide used.

## Hazard to Nontarget Organisms

Another problem associated with pesticide usage is potential injury to nontarget organisms. Most pesticide poisonings of humans and animals are caused by insecticides. Great care must be taken in selecting and using insecticides so as to minimize injury to pesticide handlers and others who may come in contact with pesticide residues. Explain to the pet owner precautions to be observed after a pet has been treated. Take care also to safeguard bees, birds, fish and other wildlife and nontarget plants. Bathe or dip pets so that drift, runoff or disposal options do not threaten nontarget organisms or water sources.

Information on pesticides and their uses is available on the label and from your county Extension office, the manufacturer's technical service representative and state regulatory agencies. These sources can provide the best information available on pesticides, their potential adverse effects and their place in a total pest management program.

Using new compounds with different modes of action will lessen the likelihood of resistance development. These include compounds that are very selective in which pests they kill and compounds that modify the pest's mating or feeding behavior.



**Consider potential hazards to nontarget organism**

---

## Chapter 3 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. A pesticide is a chemical that:
  - a. manages only insects and vertebrates
  - b. directly controls pest populations
  - c. prevents or reduces pest damage
  - d. only a certified applicator may apply
  - e. b and c
2. List the four classification methods of pesticides and give an example of each.
  - 1.
  - 2.
  - 3.
  - 4.
3. An insecticide is a pesticide used to manage \_\_\_\_\_.
4. Pesticide products labeled for use in controlling fleas are:
  - a. potentially toxic to the host animals.
  - b. formulated as shampoos and dusts.
  - c. insecticides.
  - d. available in collars.
  - e. all of the above.
5. Pesticides with chlorinated hydrocarbon chemistry are not recommended for use on cats. True or False?
6. What are the symptoms that a small animal may exhibit as a result of overexposure to an organophosphate pesticide?
7. Which two types of pesticide chemistry inhibit cholinesterase? What types of pests of small animals do these pesticides control?
8. If an animal is overexposed, it can be killed by pesticide products even though the products are labeled for use on small animals. True or False?
9. Protectants are pesticides applied to manage pests by rendering them incapable of normal reproduction. True or False?
10. A pesticide that controls more than one pest is called:
  - a. systemic.
  - b. broad-spectrum.
  - c. multipurpose.
  - d. a and c
  - e. b and c
11. What is the difference between a contact and a systemic pesticide?

12. Pesticides that contain carbon are called:
- organic pesticides.
  - inorganic pesticides.
  - synthetic pesticides.
  - These don't exist.
  - carbonic pesticides.
13. The component of the pesticide that controls the target pest is called the active ingredient. True or False?
14. List four types of synthetic organic pesticides.
15. Explain the difference between a premise spray and an area or space spray.
16. When choosing among several insecticide products, what are some of the things that must be considered?
17. What does the term "incompatibility" mean with reference to mixtures of pesticides?
18. List three types of pesticide incompatibility and give a brief definition of each.
- - 
  -
19. Where can you find information on the compatibility of pesticide mixtures?
20. What are nontarget organisms?

---

## CHAPTER 4

# PESTICIDES AND THE ENVIRONMENT

### LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Understand the various processes that affect pesticides after they are released into the environment.
- Describe ways that pesticides move off site in or on objects, plants or animals.
- Explain what groundwater is and where it is stored.
- Distinguish between point sources and non-point sources of pesticide contamination.
- Describe the actions that pesticide users can take to avoid pesticide contamination of groundwater.
- Recognize that nontarget organisms can be harmed by both pesticides and pesticide residues.

---

As our population continues to grow, so do our demands for clean water and air and an environment that does not threaten our health and safety. We have become increasingly concerned about the quality of our environment. We worry that the earth's natural resources are not only being depleted, but are also becoming polluted and unfit for human use. As a result, many of the activities that we used to take for granted are now being carefully examined for potential damage to the environment. Pesticides are just one group of chemicals being blamed for environmental degradation.

Pesticides include the products used for flea, tick and other pest control on animals and in their surroundings. How these products are used by the applicator affects the animals' well-being and can have a positive or negative impact on the environment. These products must be handled and disposed of correctly to avoid negative impacts to the applicator, the animal and the environment.

This chapter explores what happens to pesticides (their fate) after application. You will learn about groundwater and how it can be contaminated. We will discuss the effects of pesticides on nontarget organisms and the environment. For our purposes, **environment** means all of our physical, chemical and biological surroundings, such as climate, soil, water and air, and all species of plants, animals and microorganisms.



### PESTICIDE FATE

It is important to understand the behavior of chemicals used as pesticides after they have been applied according to label directions. We will describe some of the processes that change or influence the availability, effectiveness, structure or physical identity of chemicals used as pesticides.

When a pesticide is released into the environment, it is affected by various processes. Sometimes these processes are beneficial. For example,

pesticide degradation (deterioration) can remove non-essential pesticide residues from the environment. The leaching of a root-absorbed herbicide into the root zone can enhance weed management. However, some processes can be detrimental. Runoff can move a pesticide away from target sites and pests. As a result, chemical is wasted, control is reduced, and the chance of damage to nontarget plants, hazard to human health, and pollution of nearby soil and water increase.

## Adsorption

Adsorption is the binding of chemicals to soil particles. (This term is sometimes confused with absorption. See the next section.) The amount and the **persistence** of pesticide adsorption vary with pesticide properties, soil moisture content, soil acidity and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils that lack organic matter or clay are much less adsorptive.

A soil-adsorbed pesticide is less likely to volatilize, leach or be degraded by microorganisms. When pesticides are tightly held by soil particles, they are less available for absorption by plants or animals and other processes to affect them.

No small animal pest control measures are intended to be applied directly to soils. However, pesticides used in the animal's environment or on the animal and then rinsed off may come in contact with soil when the rinse water is released. At this point, the soil environment will have an effect on the persistence of the pesticide in the environment.

## Absorption

Absorption is the process by which plants, animals, humans or microorganisms take up chemicals. Absorption is another process that can transfer pesticides in the environment.

## Volatilization

Volatilization occurs when a solid or a liquid turns into a gas. A pesticide in a gaseous state can be carried away from a treated area by air currents—the movement of pesticide vapors in the atmosphere is called **vapor drift**. Unlike the drift of sprays and dusts that can sometimes be seen during an application, vapor drift is invisible.

## Runoff

Runoff occurs as water moves over a sloping surface, carrying pesticides either mixed in the water or bound to eroding soil. Runoff may occur

after a spill, when an agricultural or home lawn application is followed by a heavy rain or when gray water from an animal dip is discharged to an inappropriate site (such as open gray lines on mobile grooming units).

## Leaching

Leaching is another process that moves pesticides in water. In contrast to runoff, which occurs as water moves on the surface of the soil, leaching occurs as water moves downward through the soil. Several factors influence the leaching of pesticides. These include the water solubility of the pesticide. A pesticide that is dissolved in water can move readily with the water as it seeps through the soil. Soil structure and texture influence soil permeability (how fast the water moves through soil) as well as the amount and persistence of pesticide adsorption to soil particles. Adsorption is probably the most important factor influencing leaching of pesticides. If a pesticide is strongly adsorbed to soil particles, it is less likely to leach.

Groundwater contamination is a major concern associated with the leaching of pesticides from mixing and rinsing sites, waste disposal areas and manufacturing facilities. Refer to the next section in this chapter, "Groundwater Contamination," for information on how to prevent contamination.

## Microbial Degradation

Microbial degradation occurs when microorganisms such as fungi and bacteria use pesticides as food sources. One gram of soil may contain thousands of microbes. Microbial degradation can be rapid and thorough under soil conditions favoring microbial growth. Those conditions include warm temperatures, favorable pH levels, adequate soil moisture, aeration (oxygen) and fertility. The amount of adsorption also influences microbial degradation. Adsorbed pesticides, because they are less available to some microorganisms, are more slowly degraded.

## Chemical Degradation

Chemical degradation is the breakdown of a pesticide by processes not involving a living organism. The adsorption of pesticides to the soil, soil pH levels, soil temperature and moisture all influence the rate and type of chemical reactions that occur. Many pesticides, especially the organophosphate insecticides, are susceptible to degradation by hydrolysis in high pH (alkaline) soils or spray mixes.

## Photodegradation

Photodegradation is the breakdown of pesticides by the action of sunlight. Pesticides applied to foliage, the soil surface or structures vary considerably in their stability when exposed to natural light. Like other degradation processes, photodegradation reduces the amount of chemical present and can reduce the level of pest control. Soil incorporation by mechanical methods during or after application or by irrigation water or rainfall following application can reduce pesticide exposure to sunlight.

## GROUNDWATER CONTAMINATION

Groundwater is the water beneath the earth's surface occupying the saturated zone, the area where all the pore spaces in the rock or soil are filled with water. It is stored in water-bearing geological formations known as **aquifers**. Groundwater moves through aquifers and can be obtained at points of natural discharge such as springs or streams or by wells drilled into the aquifer.

The upper level of the water-saturated zone in the ground is called the **water table**. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the amount of water added by recharge. **Recharge** is water that seeps through the soil from rain, melting snow or irrigation.

Surface waters are visible bodies of water such as lakes, rivers and oceans. Both surface water and groundwater can be contaminated by **non-point source pollution**. This type of pollution generally results from land runoff, precipitation,

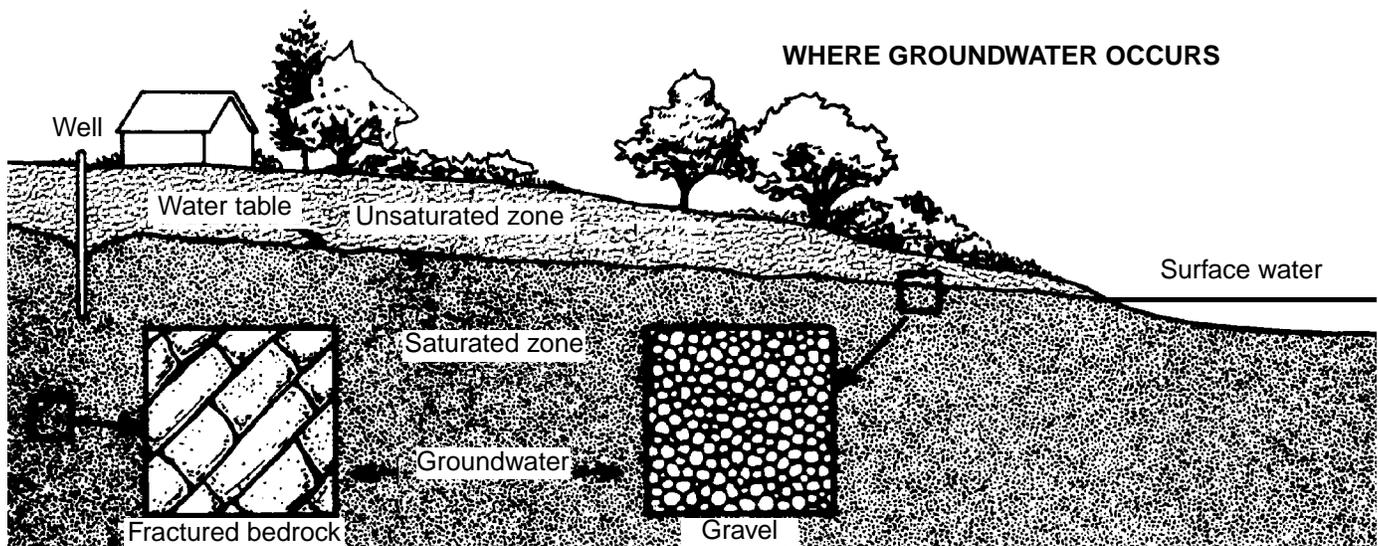
acid rain or percolation rather than from a discharge at a specific, single location (such as a single pipe). Nonpoint source pollution occurs when the rate at which pollutant materials entering water bodies or groundwater exceeds natural levels. Contamination from discharge at a single location (such as a single discharge pipe from a factory) is **point source pollution**.

The potential for groundwater pollution from improper pesticide use is a significant concern.

## Pesticides in Groundwater

Earlier in this chapter, we discussed pesticide fate and the numerous transfer and breakdown processes that occur in the environment. Those processes help determine whether pesticides reach groundwater or are degraded before reaching these underground waters. Geological characteristics, such as the depth of the water table and the presence of sinkholes, are also critical. If the water table is close to the soil surface, there may be few opportunities for adsorption and degradation to occur.

On the soil surface and within the first few inches of soil, pesticides can be volatilized, adsorbed to soil particles, taken up by plants or broken down by sunlight, soil microorganisms and chemical reactions. The extent of pesticide leaching is affected by both pesticide and soil properties. Weather conditions and management practices also affect leaching of pesticides through the soil. Too much rain or irrigation water can leach pesticides or cause runoff beyond the treatment area. A pesticide that is not volatilized, absorbed by plants, bound to soil or broken down can potentially move through the soil to groundwater.



## Keeping Pesticides Out of Groundwater and Surface Water

Michigan's aquifers currently provide a vast supply of clean water for agriculture, homes and industry. They can ensure high quality groundwater for future needs only if they are protected now. Be sure to understand how your activities, including pesticide usage and disposal, can affect groundwater and surface water.

It is very difficult to purify or clean contaminated groundwater. Treatment is complicated, time consuming, expensive and often not feasible. The best solution to groundwater contamination is to prevent it in the first place. The following pesticide applicator practices can reduce the potential for surface and groundwater contamination:

- **Use integrated pest management programs** — Minimize pesticide use by combining use of chemicals with other pest management practices.
- **Select pesticides carefully** — Read labels carefully and consult a specialist if necessary.
- **Follow label directions** — The label carries crucial information about the proper rate, timing and placement of the pesticide in that container. The label is the law. Follow all label directions.
- **Calibrate accurately** — Equipment should be calibrated carefully and often. During the calibration procedure, check the equipment for leaks and malfunctions. Be sure you are applying the label rates.
- **Measure accurately** — Concentrates need to be measured carefully before they are diluted and applied. Do not “add a little extra” to ensure the pesticide will do a better job. Such practices only increase the likelihood of injury to the treated area or animal, the cost of pest management and the chance of groundwater contamination.
- **Avoid back-siphoning** — The end of the fill hose should remain above the water level in the tub or spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when appropriate. These practices also reduce the likelihood that the hose will become contaminated with pesticides.
- **Clean up spills**—avoid spills. When spills occur, contain and clean them up quickly. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. (See Chapter 6, Pesticide Handling, Storage and Disposal.)

After pesticides reach groundwater, they may continue to breakdown but at a much slower rate because of less available light, heat and oxygen. The movement of groundwater is often slow and difficult to predict. Substances that enter the groundwater in one location can turn up years later in other locations. This means that your contamination eventually becomes someone else's contamination: if you contaminate your well, you are likely contaminating your neighbor's well and many others, too. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily identifiable. The problem is occurring underground, out of sight.

- **Dispose of wastes properly** — All pesticide wastes must be disposed of in accordance with local, state and federal laws. Instructions for triple-rinsing are included in the pesticide storage and disposal chapter. Never pour unused pesticides or rinse water into sewers, streams or other places where they will contaminate the water.
- **Store pesticides away from water sources** — Pesticide storage facilities should be situated away from wells, cisterns, springs and other water sources.

## EFFECTS ON NONTARGET ORGANISMS

Applying pesticides carelessly can harm nontarget organisms that are beneficial to agriculture, our environment and our existence. It is crucial that we protect ourselves and these species. Consider what happens to the pesticide after it has been applied to the animal you are treating. Is it rinsed off, or does it stay on the animal? Who or what may contact the residues left on the animal? What kind of fish, fowl and other organisms live where treated water is released?



### Bees and Other Pollinators

Bees and other pollinating insects are essential for successful production of many crops such as

deciduous tree fruits, small fruits, most seed crops and certain vegetables. Many pesticides, particularly insecticides, are highly toxic to pollinating honeybees and wild bees. Be aware of how bee poisonings can occur and how they can be prevented. If treating an animal's environment, do not treat or dispose of rinse water near hives or flowering plants.

## **Other Beneficial Insects and Microorganisms**

The best way to avoid injury to beneficial insects and microorganisms is to minimize pesticide usage. Use selective pesticides whenever possible and apply them only when necessary as part of a total pest management program.

## **Fish and Other Wildlife**

Pesticides can be harmful to all kinds of vertebrates. Direct effects from acute poisoning are the most recognizable impacts. Fish kills often are a direct result of water pollution by a pesticide. Pesticides can enter water via drift, surface runoff, soil erosion, leaching and, in some cases, deliberate or careless release of pesticide directly into the water. Fish kills are most often caused by insecticide contamination of small ponds or streams



with low water volume or turnover. Mobile animal grooming units must dispose of their used bath water (gray water) in a manner that does not contaminate surface or groundwater.

Bird kills from pesticides can occur in a number of ways. Birds can ingest the toxicant in granules, baits or treated seed; they may be exposed directly to the spray; they may consume a treated crop or drink or use contaminated water; they may feed on pesticide-contaminated prey.

To avoid environmental damage, use pesticides carefully, wisely and according to the instructions on the product label.

---

## Chapter 4 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

- List four processes that affect pesticides as they are released into the environment.
  - 
  - 
  - 
  -
- Airborne movement of a pesticide from the target area occurs only during application and is clearly visible when it occurs. True or false?
- \_\_\_\_\_ occurs when water moves on the soil surface. \_\_\_\_\_ occurs when water moves through the soil.
- Groundwater is stored in \_\_\_\_\_.
- If a contaminant reaches groundwater, it may continue to break down but at a much slower rate than if it were at the soil surface. Why?
- What is the difference between point source and nonpoint source pollution?
- What is the best solution to groundwater contamination?
- List five or more practices that reduce the potential for groundwater and surface water contamination.
- Fish kills most commonly result from pollution of water by \_\_\_\_\_ in small ponds or streams with low water volume or turnover.
  - herbicides
  - fungicides
  - insecticides
  - rodenticides
  - avicides
- List some of the ways nontarget animals may be killed by pesticides.

---

## CHAPTER 5

# PESTICIDES AND HUMAN HEALTH

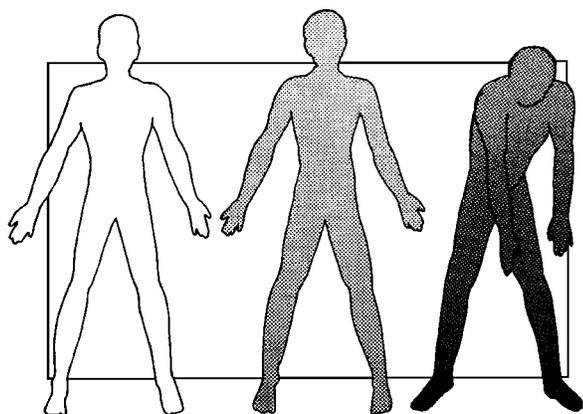
### LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- List the four routes by which your body can be exposed to pesticides.
- Understand acute toxicity and the effects.
- Understand chronic toxicity and the effects.
- Explain what the signal words on a pesticide label represent.
- Recognize some general signs and symptoms of pesticide poisoning.
- Perform appropriate first aid for pesticide exposure.
- Explain the concepts of risk, toxicity and exposure and how they relate to one another.
- Describe your legal responsibility for following personal protective requirements in pesticide labeling.
- Explain the importance of wearing gloves when you handle pesticides.
- Explain some basic guidelines for cleaning and maintaining personal protective equipment.

---

Pesticides are generally toxic to living organisms. They are specifically designed to be toxic to those organisms we consider pests. However, living organisms share some basic features, and a substance that is toxic to one species may be harmful to another, including humans.



This chapter explains how pesticides enter the body, how to protect yourself from contamination and how to perform first aid if contamination does occur. An explanation of terms will help

clarify this information. The words “toxicity” and “hazard” often are used interchangeably when describing a pesticide’s toxic effects. However, they are not the same. **Toxicity** is a measure of the capacity of the pesticide to cause injury. It is a property of the chemical itself and its concentration. **Hazard**, on the other hand, is the potential for injury. It reflects both the toxicity of the pesticide and the likelihood that significant exposure will occur in a particular situation. Pesticide applicators should be concerned with the hazards associated with exposure to the chemical not exclusively with the toxicity of the chemical itself.

To avoid or minimize the hazards of pesticide use, know what you are using and how to use it. This means you must read the label carefully and follow the instructions. Poisonings do occur as the result of occupational exposure, careless use, misuse or mishandling. The attitude of the applicator is of utmost importance. If applicators mistakenly think they know exactly how to use a pesticide or neglect or ignore precautions they should take, accidents are more likely to occur. Taking adequate precautions and practicing good common sense with safety in mind minimizes the potential for accidents from pesticide usage.

## EXPOSURE: HOW PESTICIDES ENTER THE BODY

To cause an adverse effect (including death), a pesticide must first enter the body and reach a susceptible site. Four primary routes through which a pesticide can enter the human body are: the skin (dermal), the lungs (inhalation), the mouth (oral) and the eyes (ocular).

### Dermal Exposure

The skin is an important route of pesticide entry into the body. Dermal absorption may occur from a splash, spill or drift when mixing, loading, applying or disposing of pesticides. It may also result from being exposed to plant residue or cleaning or repairing contaminated equipment.

Even small amounts of chemical allowed to remain on the skin and be absorbed into the body, can poison a person. Parts of the body vary in their ability to absorb pesticides. The statistics in Table 1, obtained from a study of volunteers, show that you should take special care to protect the scalp, ear canal and forehead, as well as the groin area. Note that the scrotal area is 100 percent absorptive. A hat with a wide brim and or face shield would serve to protect the three head areas, and a waterproof apron can protect the groin.

Table 1

Anatomy	Percent Absorption*
Scalp	32.1
Ear canal	46.5
Forehead	36.3
Forearm	8.6
Palm of hand	11.8
Abdomen	18.4
Scrotum	100.0
Ball of feet	13.5

\*Parathion, an agricultural pesticide, was used in this study.

The scrotal area and the head tend to be the most absorptive areas, though cuts, abrasions and skin rashes can enhance absorption in other parts of the body. Pesticide formulations vary in their absorbency through skin. In general, wettable powders, dusts and granular pesticides are not as readily absorbed as oil-based liquid formulations such as emulsifiable concentrates.

### Ocular (Eye) Exposure

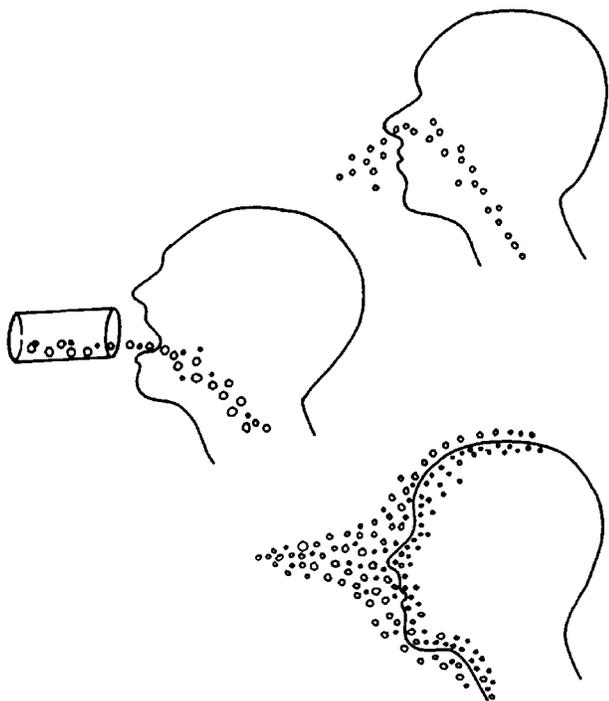
Under certain conditions and with certain pesticides, absorption through the eyes can be significant and particularly hazardous. Eyes are very sensitive to many pesticides and, considering their size, are able to absorb surprisingly large amounts of chemical. Serious eye exposure can result from a splash or spill, drift, or rubbing the eyes with contaminated hands or clothing. Avoid this type of exposure by always wearing protective eye covering such as goggles or a face shield.



Wear the correct amount of personal protective equipment when working with pesticides.

### Inhalation Exposure

Protecting the lungs is especially important because pesticide powders, dusts, gases, vapors and especially very small spray droplets can be inhaled during mixing, loading or application or when pesticides are applied in confined areas. Once breathed into the lungs, pesticides can enter the bloodstream rapidly and completely. If inhaled in sufficient amounts, pesticides can damage nose, throat and lung tissue. The label will indicate whether face masks or respirators are required when using specific pesticides.



## Oral Exposure

Accidental oral exposure occurs most frequently when pesticides have been taken from the original labeled container and put into an unlabeled bottle or food container. Unfortunately, children are the most common victims. Children under age 10 are the victims of at least half of the accidental pesticide deaths in the United States. Keep pesticides in their original containers.

Oral exposure also occurs when liquid concentrates splash into the mouth during handling or when cleaning equipment. The mouth should never be used to clear a spray line or to begin siphoning a pesticide. Chemicals can also be swallowed when eating, drinking or smoking, or even licking one's lips. Many pesticides are rapidly and completely absorbed by the intestinal tract, so it is sound advice to **wash hands and face thoroughly before eating, drinking or smoking**. Do not eat or smoke while handling pesticides.

## TOXICITY AND POTENTIAL HEALTH EFFECTS OF PESTICIDES

The toxicity of a particular pesticide is determined by subjecting test animals (usually rats, mice, rabbits and dogs) to various dosages of an active ingredient and to each of its formulated products. From these studies, acute and chronic toxicity and effects are determined. Then signal words are assigned and proper handling procedures are determined to reduce risk.

## Acute Toxicity and Acute Effects

Acute toxicity is the capacity of a pesticide to cause injury from a single exposure. This is the most common type of pesticide poisoning.

**Acute toxicity** is determined by at least three methods:

1. Dermal toxicity is determined by exposing the skin to the chemical.
2. Inhalation toxicity is determined by permitting the test animals to breathe vapors of the chemical.
3. Oral toxicity is determined by feeding the chemical to test animals.

The harmful effects that occur from a single exposure by any route of entry are termed acute effects. In addition, the effect of the chemical as an irritant to the eyes and skin is examined under laboratory conditions.

Acute toxicity is usually expressed as LD50 (lethal dose 50) and LC50 (lethal concentration 50). This is the amount or concentration of a toxicant required to kill 50 percent of a test population of animals under a standard set of conditions. LD50 values of pesticides are recorded in milligrams of pesticide per kilogram of body weight of the test animal (mg/kg) or in parts per million (ppm). LC50 values of pesticides are recorded in milligrams of pesticide per volume of air or water (ppm). To put these units into perspective, 1 ppm can be compared to 1 inch in 16 miles or 1 minute in 2 years.

The LD50 and LC50 values are used to compare the toxicity of various active ingredients as well as different formulations of the same active ingredient. The lower the LD50 value of a pesticide, the less it takes to kill 50 percent of the population, and therefore the greater the acute toxicity of the chemical. Pesticides with high LD50 values are considered the least acutely toxic to humans when used according to the directions on the product label. If the label does not state the LD50, this information can be obtained from the product's Material Safety Data Sheet (MSDS).

Acute toxicities are the basis for selecting the appropriate signal word (toxicity categories) to be used on a product label.

## Signal Words

Signal words indicate the toxicity of a pesticide. The signal word may reflect the active ingredient's toxicity, the inert ingredient's toxicity, or the toxic affect of their combined activity. Those pesticides that are classified as "highly toxic," on the basis of either acute oral, dermal or inhalation

toxicity, must have two signal words: **DANGER** and **POISON** (in red letters) and a skull and crossbones prominently displayed on the package label. **PELIGRO**, the Spanish word for danger, must also appear on the labels of highly toxic chemicals. Acute oral LD50 values for pesticide products in this group range from a trace to 50 mg/kg. As little as a few drops of such a material taken orally could kill a 150-pound person.

Some pesticide products carry the signal word **DANGER** without the skull and crossbones symbol. This occurs when possible skin irritation or eye effects are more severe than suggested by the acute toxicity (LD50) of the product.

Pesticide products considered “moderately toxic” must have the signal words **WARNING** and **AVISO** (Spanish) displayed on the product label. Acute oral LD50 values range from 50 to 500 mg/kg. From 1 teaspoonful to 1 ounce of this material could kill a 150-pound person.

Pesticide products classified as either “slightly toxic or relatively nontoxic” are required to have the signal word **CAUTION** on the pesticide label. Acute oral LD50 values are greater than 500 mg/kg.

## Chronic Toxicity and Chronic Effects

**Chronic toxicity** is the ability of repeated, prolonged exposure to a pesticide to cause injury. A number of pesticides cause this type of effect. Chronic toxicity is very dangerous because pesticide applicators do not realize anything is wrong until the injury has progressed. Applicators should remember that the absence of any immediate effect is not necessarily an indication of no exposure or safe use.

The chronic toxicity of a pesticide is determined by subjecting test animals to long-term exposure to an active ingredient. The harmful effects that occur from repeated doses over a period of time are termed **chronic effects**. Some possible chronic effects from exposure to certain pesticides include birth defects (teratogenesis); toxicity to a fetus (fetotoxic effects); production of tumors (oncogenesis), either benign (non-cancerous) or malignant (cancerous; the process is carcinogenesis); genetic changes (mutagenesis); blood disorders (hemotoxic effects); nerve disorders (neurotoxic effects); and reproductive effects. Pesticides are required to include chronic toxicity warning statements on the product label if effects may occur. The chronic toxicity of a pesticide is more difficult to determine through laboratory analysis than the acute toxicity.

Because of the variety of effects that pesticides can cause and the amount of time it might take

for the effects to appear, it is prudent to reduce exposure as much as possible to all pesticides. When effects do occur, treatments are generally available, but prevention is much preferable to treatment, especially because some of the effects are irreversible.

## FIRST AID FOR PESTICIDE POISONING

Most pesticide poisonings result from careless use, improper storage or ignorance. By law, everything you need to know to apply pesticides safely is on the pesticide label. Therefore, the most important rules to follow when using pesticides are to **read and follow the instructions and precautions on the label**. Read the label before buying the product, opening the container, mixing or applying the solution, and before disposing of unused product or empty containers.

## Symptoms and Signs of Pesticide Poisoning

Pesticides are designed to be toxic to pests. Human exposure to toxic levels results in a variety of general symptoms and signs of poisoning. These vary with the pesticide, the amount absorbed and the general health of the individual. Some of the most common symptoms and signs are:

- **When a substance is touched:** skin irritation (drying and cracking), skin discoloration (reddening or yellowing) or itching.
- **When the substance is inhaled:** burning sinuses, throat and lungs, accompanied by coughing, hoarseness and upper respiratory congestion.
- **When the substance is ingested:** mouth and throat irritation, chest pains, nausea (stomach ache), diarrhea, muscle twitching, sweating, headache and weakness.

Some of the symptoms begin immediately upon exposure; others are delayed for several hours or even days.

**Insecticides.** Insecticides are the type of pesticide that the small animal manager will most commonly be using. Symptoms differ with various insecticides, but all depend on both the amount and duration of exposure. Insecticides of most concern are the organophosphates and carbamates, which inhibit cholinesterase, a chemical critical for normal functioning of the nervous system. Symptoms may begin almost immediately after exposure to a direct cholinesterase inhibitor. Symptoms may be delayed several hours. Onset

of symptoms more than 12 hours after exposure generally excludes organophosphate or carbamate insecticide poisoning, unless it is chronic poisoning from repeated exposures.

The most commonly reported symptoms, which often appear in progression and depend, in part, on whether the chemical was touched, inhaled or ingested, are:

- Headache.
- Visual disturbances (blurred vision).
- Pupillary abnormalities (primarily pinpoint pupils, but on rare occasions, dilated pupils).
- Greatly increased secretions such as sweating, salivation, tearing and respiratory secretions.

Normal Pupils



Constricted (pinpoint) pupils

More severe poisonings result in nausea and vomiting, pulmonary edema (the air spaces in the lungs begin to fill with fluid), changes in heart rate, muscle weakness, respiratory paralysis, mental confusion, convulsions or coma, and death.

Groomers may be especially vulnerable to intoxication from pet insecticides if they are careless in their daily work practices. Inhalation and absorption through the skin are the most common means of insecticide exposure. Groomers dipping or spraying animals in a poorly ventilated area with skin exposure to the chemicals may expect to absorb considerable amounts of insecticide. The symptoms of over-exposure may not be noticeable in the early stages, but prolonged exposure may result in frequent headaches, irritability, lack of energy and depression.

Groomers and veterinary clinic personnel must take special precautions to protect their health when working regularly with pet dips and sprays. A basic understanding of the insecticides used in dips, sprays and collars is essential for those frequently using the products. Review the information found in Chapter 3, Pesticides.

Applicators can use EPA-approved flea and tick insecticides daily by following the products' label directions, wearing the appropriate PPE and working in a well ventilated workplace.

## Cholinesterase Tests

Cholinesterase tests are used only for cholinesterase-inhibiting insecticides: organophosphates and carbamates. These classes of insecticides are found in products commonly used to control and manage small animal pests. Urine and blood analysis, together with symptoms, are used to diagnose most herbicide, fungicide and non-cholinesterase-inhibiting insecticide exposure and poisonings.

If you work with organophosphate or carbamate insecticides for an extended time (small animal managers/groomers, farmers, pesticide applicators, pesticide manufacturers, formulators), you should establish a regular cholinesterase test program with your doctor. For a groomer, such a program might consist of one (initial) cholinesterase test to determine a baseline level. This test should be made in the off-season (possibly when flea controls are not being applied.) Then, during a high-use period for insecticides, similar tests are conducted and the results are compared with the baseline level. Through this testing procedure, you can learn of any changes in cholinesterase levels when you are exposed to pesticides. When cholinesterase levels are low, your doctor may advise you to limit or possibly stop your exposure to these pesticides until the cholinesterase level returns to normal.

For more information, contact your doctor or the state health department.

## First Aid

**When you are working with pesticides, it is always best to work with someone.** Arranging to have someone with you may sometimes be an inconvenience, and it may seem like an unnecessary precaution—until something happens.

If you are with someone who is exposed to a pesticide, immediately begin first aid treatment or assist the victim in any way you can. Always be careful not to contaminate yourself. If there is any cause to seek medical attention, either call a doctor or take the victim directly to a doctor. Take the pesticide label or labeled container with you.

First aid treatment varies according to the type of exposure. Become thoroughly familiar with all of the appropriate procedures. Learn them ahead of time—you probably won't have time to look them up if you ever need them.

## Dermal Exposure

Observe the manufacturer's recommendations for first aid. In addition, and if the situation demands:

- Remove clothing, if it has been contaminated.
- Drench skin with water.
- Wash thoroughly, including hair if necessary. Detergents and commercial cleansers are better than soap.
- Rinse thoroughly, using lots of soap and water.
- Wash again and rinse.
- Dry and wrap the person in a blanket.
- Where chemical burns of the skin have occurred, cover the area loosely with a clean, soft cloth. Avoid the use of ointments, greases, powders and other medications.

## Inhalation Exposure

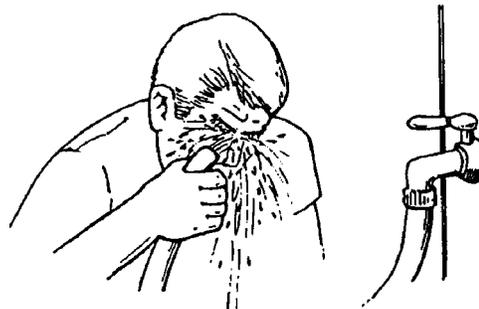
Observe the manufacturer's recommendations for first aid. In addition, and if the situation demands:

- Get to fresh air immediately.
- If you are with someone who has been poisoned, move the victim to fresh air immediately.
- Do not attempt to rescue someone who has been poisoned in an enclosed area if you do not have the proper respiratory equipment.
- Loosen all tight clothing.
- If breathing has stopped or is irregular, give mouth-to-mouth resuscitation.
- Keep the victim as quiet as possible.
- Prevent chilling (wrap in blankets, but do not overheat).
- If you are with a victim who is having convulsions, watch his/her breathing and protect the person from falling and striking the head. Keep the chin up so the air passages will remain free for breathing. Do not put anything in the victim's mouth.
- Do **not** give alcohol in any form to the victim.

## Eye Exposure

Observe the manufacturer's recommendations for first aid. In addition, and if the situation demands:

- Hold eyelids open and wash eyes with a gentle stream of clean running water. **Use large amounts of water immediately—delay of even a few seconds greatly increases the possibility of injury.** Continue washing for 15 minutes or more.
- Do not use medications in the wash water—use pure water.



Use clean water to gently flush pesticides from the eyes for at least 15 minutes.

## Oral Exposure

Observe the manufacturer's recommendations for first aid. In addition, and if the situation demands:

- If a pesticide has gotten into your mouth but has not been swallowed, rinse your mouth with large amounts of water.
- If the pesticide has been swallowed, the most important consideration is whether to induce vomiting—the decision must be made quickly and correctly. Where specific instructions are given, always follow label directions. Beyond that, never induce vomiting if:
  1. The victim is unconscious or is having convulsions.
  2. The pesticide is **corrosive**. A corrosive substance is any material, such as a strong acid or alkali (base), that causes chemical destruction of living tissues. Poisoning symptoms include severe pain and a burning sensation in the mouth or throat.

In attempting to induce vomiting, it is important to use safe and effective procedures. Vomiting should be induced for an **adult** with two tablespoons (1 ounce) of Syrup of Ipecac (this can be obtained from your pharmacist without a prescription) and two glasses of water. Induce vomiting in a **child** with 1 tablespoon (1/2 ounce) of Syrup of Ipecac and one glass of water.

If Syrup of Ipecac is not available, induce vomiting by drinking one or two glasses of water and then touching the back of the throat with your finger. **Salt water should not be used to induce vomiting.**

- The victim should be lying face down or kneeling forward while retching or vomiting, thus preventing vomitus from entering the lungs and causing further damage.
- Collect some of the vomit for the doctor—it may be needed for chemical tests.
- **Do not waste a lot of time attempting to induce vomiting—get to a hospital as soon as possible.**

Where the label identifies specific antidotes, this information is intended for use by a doctor. Antidotes should not be administered except under the direction of a physician or other medical professional. Taken improperly, antidotes can be more harmful than the pesticide itself.

The name, address and telephone number of the physician, clinic or hospital emergency room that will provide care in the event of a pesticide poisoning should be clearly posted at all work sites.

## **SAFETY: PROTECT YOURSELF FROM PESTICIDES**

The greatest risk to the pesticide applicator occurs during application and mixing and loading of pesticide concentrates. Though application of diluted material is usually less hazardous, the hazard increases when significant drift occurs or when appropriate safety and application procedures are not followed. The danger of exposure also exists when people are cleaning up pesticide spills, making equipment repairs and entering treated areas prematurely.

Personal protective equipment (PPE) is clothing and devices that are worn to protect the human body from contact with pesticides or pesticide residues. Personal protective equipment includes such items as coveralls or protective suits, footwear, gloves, aprons, respirators, eye-wear and head gear. Remember:

$$\text{RISK} = \text{toxicity} \times \text{exposure}$$

To reduce risk, choose pesticides with lower toxicity and reduce exposure by wearing PPE. Pesticide labeling lists the minimum personal protective equipment you must wear while

handling that pesticide. Sometimes the labeling lists different requirements for different activities.

The following is a brief discussion of the various types of protective clothing and equipment, and a review of some important considerations for their selection.

## **Clothing**

At a minimum, protective clothing should include a long-sleeved shirt and long trousers that are clean and made of a tightly woven fabric or a water repellent material. A T-shirt and shorts are not adequate protection when applying pesticides. Common denim provides good protection. Specific items of protective clothing are described in the following sections. For more information, see Extension bulletin E-2150, "Choosing Clothing for Pesticide Safety."

## **Choosing Chemical-resistant Materials**

Always read the pesticide labeling to see what materials are resistant to the pesticide product. The Extension agents, pesticide producers, or personal protective equipment manufacturers and distributors may also offer guidance. Refer to the MSDS sheets to obtain information that may help in the selection process.

Remember, all PPE has a limited life (length of time it will provide adequately protection). Protection, durability and longevity differ among materials. How they are used, the length of time, and the type of chemicals to which they are exposed affect their performance. Replace your PPE frequently.

Neoprene, nitrile, polyvinyl chloride (PVC) and butyl rubber are chemical-resistant materials available in various thicknesses as gloves, coveralls, hoods, boots and other PPE. Each varies in the ability to withstand chemical permeation. Select the material that best suits your particular needs. Latex rubber has natural pores and holes and is not recommended for protection against chemical exposure.

## **Coveralls, Aprons, Raincoats**

Coveralls, whether disposable or reusable, vary in their comfort and durability and in the degree of protection they provide. Coveralls should be made of sturdy material such as cotton, polyester, a cotton-synthetic blend, denim or a non-woven fabric. A liquidproof apron, raincoat or rainsuit should be worn when pouring and mixing concentrates and when using highly toxic pesticides—coveralls usually do not provide adequate protection against spills and splashes of these

chemicals. Wear a rainsuit whenever mist or spray drift are likely to substantially wet work clothes or coveralls. Liquidproof aprons and rainsuits should be made of rubber or a synthetic material resistant to the solvents in pesticide formulations. The apron should cover the body from the chest to the boots.

## Gloves

Wear unlined, chemical-resistant gloves when handling or applying pesticides. Gloves should be long enough to cover the wrist and should not have a fabric wristband. Check gloves carefully to be sure there are no holes—fill them with water and squeeze. Each exposure to a pesticide reduces the gloves' ability to protect you the next time you wear them. Gloves are intended to be disposable—replace them often. Be certain gloves are approved for use with the chemicals you intend to use. Some rubber products react with certain solvents and become sticky as the rubber dissolves. If this occurs, dispose of the gloves and use gloves approved for use with the specific pesticide. For most jobs, wear shirt sleeves outside of the gloves to keep pesticides from running down the sleeves into the gloves. But if you are working with your hands and arms overhead, put the gloves outside of the sleeves and turn up the cuff of the gloves to catch material that might run down your arms. Wash chemicals off the gloves with soap and water before removing them so you don't contaminate your hands when removing the gloves.

## Hats

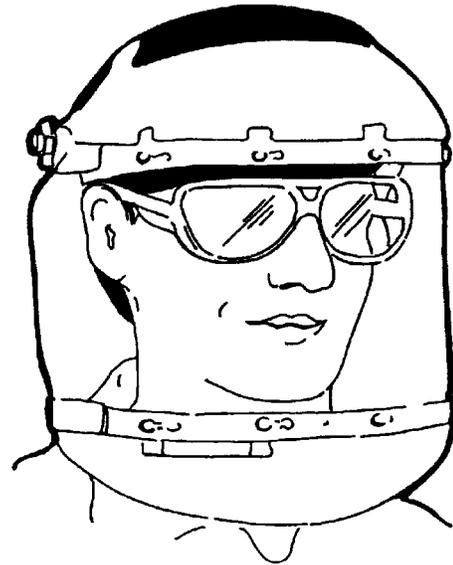
Wear head covering when handling pesticides. A hat should be liquidproof and have a wide brim to protect the face, ears and neck. Hats should be either disposable or easy to clean with soap and water—they should not contain any absorbent materials such as leather, straw or cloth. Baseball caps do not provide adequate protection.

## Shoes and Boots

Boots should be unlined and made of rubber. Because of their absorbency, never wear boots of leather, canvas or cloth when handling pesticides. Wear trouser legs outside the boots to prevent pesticides from running down the leg and into the boot. Wash your boots after each use. Replace them after repeated chemical exposure and wear.

## Goggles and Face Shields

Wear tight-fitting, non-fogging goggles or a full-face shield when there is any chance of getting pesticide in your eyes. This is especially important when pouring or mixing concentrates or handling dusts or toxic sprays. Those who wear contact lenses may want to consult an eye doctor or physician before using pesticides.



Goggles provide a secure shield around the entire eye area, protecting against hazards coming from many directions. Wear goggles with indirect ventilation when exposed to splash hazards. Face shields that are cupped inward toward your throat give better protection than straight face shields. Goggles and face shields should be kept clean at all times. Wash them with soap and water, and sanitize by soaking equipment for two minutes in a mixture of 2 tablespoons chlorine bleach in a gallon of water. Rinse thoroughly with a clean cloth and allow to air dry. Pay particular attention to the goggle headbands. They are often made of absorbent materials and require regular replacement.

## Respirators

For many toxic chemicals, the respiratory (breathing) system is the quickest and most direct route of entry into the circulatory system. From the blood capillaries of the lungs, the toxic substances are rapidly transported throughout the body. Respiratory protective devices vary in design, use and protective capability. In selecting a respiratory protective device, first consider the degree of hazard associated with breathing the toxic substance, and then understand the specific uses and limitations of the available equipment.

Select a respirator that is designed for the intended use, and always follow the manufacturer's instructions on use and maintenance of your respirator for various chemicals or groups of chemicals. Select only equipment approved by the National Institute of Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). The NIOSH approval numbers begin with the letters TC.

You can check the fit of a respirator by placing your hands over the cartridges, inhaling and holding your breath. The respirator should collapse and stay collapsed on your face. Also, check the information provided by the cartridge manufacturer to determine when the respirator cartridges will expire. Be aware that beards and other facial hair keep the respirator from sealing around your face and therefore make the respirator useless.

After each use of the respirator, remove all mechanical and chemical filters. Wash and sanitize the face piece using the same procedure recommended for goggles. Store the respirator face piece, cartridges, canisters and mechanical filters in a clean, dry place, preferably in a tightly sealed plastic bag. Do not store your respirator with pesticides or other chemicals.

The following table suggests additional considerations for pet groomers to consider when striving for improved working and breathing conditions.

## Laundering Pesticide-contaminated Clothing

Wash all protective clothing and equipment at the end of each day of use. Store and wash pesticide-contaminated clothing separately from the family laundry. Remember to wear gloves during these handling and laundering steps and be sure to check the label for any specific instructions. Note: Discard clothing that has become saturated with a concentrate.



Some residues may be removed by hosing the contaminated clothing with water or presoaking it in an appropriate container. Washing in hot water removes more pesticide from the clothing than washing in cooler water. The hotter, the better. Cold water might save energy, but it is relatively ineffective in removing pesticides from clothing.

### Six Steps to Breathing Easy in the Grooming Shop

1.	Identify possible lung irritants in your shop. For example: animal dander, animal antigens, animal hair, bacteria, chemicals and other synthetic products.
2.	Reduce the amount of lung irritants. For example: use a hair removal system, keep your shop clean, use proper ventilation when using chemicals, and adjust your shop size to recommended standards (150 sq. ft. per groomer).
3.	Obtain regular medical care. Explain to your physician your profession and the hazards you are exposed to when you work.
4.	Limit or eliminate smoking.
5.	Recognize signs and symptoms of lung disorders, including shortness of breath, wheezing, coughing, sneezing and chest tightness.
6.	Start prevention BEFORE symptoms appear.
Adapted from the National Dog Groomers Association	

Laundry detergents—whether phosphate, carbonate or heavy-duty liquids—are similarly effective in removing most pesticides from fabric. However, heavy-duty liquid detergents typically remove oil better and therefore are more effective than other detergents in removing emulsifiable concentrates. The ease of pesticide removal through laundering does not depend on toxicity but on the formulation of the pesticide. **Bleach or ammonia may possibly help remove or break down certain pesticides. Never mix bleach and ammonia because they react to form chlorine gas, which can be fatal for those who inhale it.**

Wash clothing at the highest water level. After washing, it is important to rinse the washing machine by running it through the complete cycle using hot water and the same detergent. Line-drying clothing is recommended for two reasons. First, it eliminates the possibility of residues collecting in the dryer; second, residues of many pesticides will break down when exposed to sunlight. Wash hands and arms after the laundering procedure. Keep protective clothing separate from the pesticide storage area. For more laundering information, see Extension bulletin E-2149, “10 Tips for Laundering Pesticide Soiled

Clothing.” Magnets that can be placed on the washing machine with these instructions are also available as Extension bulletin E-2413.

## Personal Care After Application

After cleaning application equipment and protective clothing, personal cleanup is next. In particular, wash your hands and face thoroughly with soap and hot water before eating, drinking or smoking. Shower and change clothing as soon as possible. Be sure to scrub your scalp, neck, and under your nails.



---

## Chapter 5 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. What is the difference between toxicity and hazard?
2. The scalp, ear canal and forehead are especially vulnerable to dermal exposure to pesticides. True or False? What could you wear to protect these areas?
3. Pesticide residues are absorbed through the skin at relatively the same rate on different parts of the body. True or false?
4. \_\_\_\_\_ are the most common victims of oral exposure.
5. Give an example of inhalation exposure and oral exposure.
6. Toxicity from small, repeated exposures to a pesticide over a period of time is called \_\_\_\_\_. Toxicity from one exposure is \_\_\_\_\_.
7. Which LD50 is representative of a highly toxic pesticide?
  - a. 640 mg/kg
  - b. 5,800 mg/kg
  - c. 12,840 mg/kg
  - d. 380 mg/kg
  - e. 46 mg/kg
8. The signal word on a pesticide label indicates the pesticide's:
  - a. effectiveness.
  - b. toxicity.
  - c. compatibility.
  - d. formulation.
  - e. ability to cause tumors.
9. Which signal word(s) would indicate the product is least toxic to an applicator?
  - a. DANGER
  - b. CAUTION
  - c. WARNING
  - d. DANGER-POISON
  - e. Skull and crossbones
10. Where can the applicator find out what he or she needs to know to apply pesticides safely?
11. Insecticides of most concern are the \_\_\_\_\_ and \_\_\_\_\_ which inhibit cholinesterase.
12. \_\_\_\_\_ is a chemical critical for normal functioning of the nervous system that may be inhibited by some insecticides.
13. Who should receive regular cholinesterase testing?
14. What pesticide-related document should you take with you when you take a pesticide poisoning victim to the doctor?

15. List the first aid measures you should do when someone has been dermally exposed to pesticides.
16. Never induce vomiting in a pesticide poisoning victim if:
- the victim is a child.
  - the victim is unconscious or is having convulsions.
  - the pesticide involved is corrosive.
  - all of the above.
  - b and c only.
17. List the first aid measures you should perform when someone has inhaled a pesticide.
18. To reduce the risk of human pesticide poisoning, the applicator should choose pesticides which have lower \_\_\_\_\_ and reduce \_\_\_\_\_.
19. A T-shirt, shorts and baseball hat provide adequate protection for someone applying pesticides. True or False?
20. Gloves and boots worn when handling most pesticides should be made of:
- canvas
  - leather
  - lined rubber
  - unlined rubber
  - none of the above
21. How frequently should protective clothing be laundered?
22. Pesticide-contaminated clothing should be washed separately from the family laundry in hot water with laundry detergent. True or False?

---

## CHAPTER 6

# PESTICIDE HANDLING, STORAGE AND DISPOSAL

### LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- List some safety guidelines for opening pesticide containers and handling pesticides.
- Describe the components of a proper pesticide storage area.
- Describe the cleaning and disposal procedures for empty pesticide containers.
- List safety precautions for transporting pesticides in a vehicle.
- List what you should do in the event of a pesticide fire.

---

Danger of exposure always exists whenever you are handling pesticides. The greatest risk to the applicator is in handling and applying toxic materials and in using concentrated pesticides. Therefore, the applicator must use safety measures and also be familiar with what action to take in the event of a spill, leak or fire. Study the safety precautions described in this chapter and use them whenever you are handling, applying, transporting or storing pesticides. You will find that most precautions are common sense.

### HANDLE PESTICIDES SAFELY

Opening pesticide containers, connecting application equipment or transferring pesticides to another container for application all entail the possibility of exposure. Here are some general safety guidelines for these procedures.

- Review the label before opening the container so that you are familiar with current directions.
- Always wear adequate protective clothing and equipment. Put them on before handling or opening a pesticide container. Remember to wear a respirator or appropriate form of eye protection if any chance of pesticide inhalation or eye exposure exists. Never eat, drink or smoke while handling pesticides.
- Carefully choose the pesticide handling area. It should be away from other people and pets. Pesticides should not be used in areas where a spill or overflow could get into a water supply. Be sure there is adequate ventilation and light. Have a supply of clean water and soap available. Hydrated lime and bleach can be used to neutralize and clean surfaces where spills occur. Clay, cat box filler, activated charcoal or similar material is also helpful to soak up spills or leaks. If possible, do not work alone.
- Do not tear paper containers to open them—use a sharp knife or scissors.
- When pouring from a container, keep the container at or below eye level and avoid splashing or spilling on your face or protective clothing.
- Never use your mouth to siphon a pesticide from a container.
- If an accident occurs, attend to it immediately. Remove any contaminated clothing and wash yourself thoroughly with soap and water. Take care of any spills on the floor or the ground.
- Measure accurately, follow label instructions and use only the amount necessary. Newer measuring devices such as “tip and pours”

are a great help in handling small amounts of concentrated pesticide. Keep all measuring devices (spoons, cups, scales) in the pesticide storage area, and label them to avoid their being used for other purposes. Rinse measuring cups and put the rinse water into the system being treated.

- Triple-rinse pesticide containers (if applicable) as soon as they are emptied—residues can dry and become difficult to remove later. Pour the rinsewater into the application equipment being used to avoid disposal problems and product waste. Replace container caps and close bags. Return them to the pesticide storage area.
- Equipment should be operational and calibrated before filling and using.
- When adding water to a spray mixture, make sure the water hose remains above the level of the mixture, never contacting it. This prevents contamination of the hose and avoids the possibility of back-siphoning the pesticide into the water source.
- Never leave equipment unattended while it is being filled.



If squeeze bottles are used for application equipment, be sure to label the bottle, stating its contents and its use. Triple-rinse the bottle when the application is complete.

- Chemical residues can cause incompatibility problems—always clean application equipment after use.

Keep in mind that water characteristics influence the effectiveness of some pesticides. Alkaline water, for example, leads to chemical breakdown of many pesticides, including organophosphates and carbamates. The recommended water pH for mixing most pesticides is between 5.0 and 7.0. Buffers and acidifying agents can be used to adjust the pH of the water.

## STORE PESTICIDES SAFELY

Proper pesticide storage helps prolong chemical shelf life while protecting the health of people, animals and the environment. A number of conditions are essential for safe pesticide storage. Consult the pesticide product label for specific storage information. Other storage guidelines are presented in the following sections.

### Storage Area

Keep all pesticides out of the reach of children, pets and careless adults. Store pesticides in a locked, secure place, such as a separate building or storage room. Around the home, the same rule applies—lock them up. A storage area should be located where water damage is unlikely to occur. Soil and land surface characteristics should be considered when constructing a storage facility to prevent contamination of surface or groundwater by drainage, runoff or leaching. In certain situations, dikes may be warranted. For pesticide storage outdoors, erect a fence to prevent unauthorized entry and reduce the chance of theft and vandalism. In addition:

- Post highly visible warning signs on walls, doors and windows to indicate to anyone attempting to enter the facility that pesticides are stored there. Also post “No Smoking” signs.
- Keep storage areas locked.
- Store pesticides away from food, feed, potable water supplies, veterinary supplies, seeds and protective equipment. This prevents contamination from fumes, dusts or spills, and reduces the likelihood of accidental human or animal exposure.
- Ventilate the storage area and keep it relatively free from temperature extremes. Very high or low temperatures can cause pesticide deterioration. Exhaust fans directed to the outside reduce the temperature and dust or

fume concentrations. Fireproof construction with a sealed cement floor is the best.

- Keep pesticides cool, dry and out of direct sunlight.
- Keep plenty of soap and water available in or close to the storage area. A fire extinguisher approved for chemical fires, first aid equipment and emergency telephone numbers should all be readily available.
- Store volatile pesticides separately to avoid possible cross-contamination of other products.

## Pesticide Containers

Store pesticides in their original containers only. Do not use soft drink bottles, fruit jars or other types of non-pesticide containers. Serious poisonings could result because small children as well as most adults associate the shape of a container with its contents.



**Never store pesticides in food or beverage containers. They may be swallowed accidentally.**

If other containers are used as application devices, such as squeeze bottles or empty, clean detergent bottles, measure only the amount needed for that application, and clearly label the container with the product being used. Have complete label information readily available. When the application is complete, triple-rinse the container that was used for the application. These containers should be labeled, "For Pesticide Use Only." One container, one usage. Remember, mix only the amount you will use for the application being performed.

Keep the original label attached to the container. To keep a label legible, protect it with transparent tape or lacquer. Remember, the label is the most important safety factor in the use of pesticides—do not let it become damaged or destroyed.



**Containers should be used for only one purpose and labeled to identify their contents.**

Never lend a pesticide in an unmarked or unlabeled container. Those who use the pesticide should not rely on verbal directions. Close containers securely when not in use. Dry formulations tend to cake when wet or subjected to high humidity. Opened bags of dry formulations can be placed into sealable plastic bags or other suitable containers. This reduces moisture absorption by the material and prevents spills should a tear or break occur.

If wall units are used to hold and meter bulk product, they must be labeled to identify what they contain. Complete label information must be readily accessible. If these wall units hold more than one product in separate compartments, there should be a separate discharge line for each product. Using one line for all products results in cross-contamination because there is no method for flushing the line between product selection and use.

Store liquid formulations and small containers of dry formulations on metal shelving. Metal shelving does not absorb spilled pesticides and is easier to clean than other surfaces.

Store pesticides in the original containers, under cool conditions, on lower shelves. Too much heat can cause the container to break or explode. Containers should not extend beyond the edge of the shelf where they could be bumped or knocked off.

Check containers regularly for leaks or breaks. If a leak or break occurs, place the container inside another container, or transfer the contents to an empty container that originally held the same material and has the same label attached.

## Shelf Life of Pesticides

Keep an inventory of all pesticides in storage and mark each container with the purchase date.

If a product has an effective shelf life recorded on the label, you will know how long the product should remain usable. If doubts or questions about the shelf life of a pesticide, call the dealer or manufacturer. Pesticide deterioration may be apparent during mixing as excessive clumping, poor suspension, layering or abnormal coloration. Sometimes, however, pesticide deterioration from age or poor storage conditions is apparent only after application—poor pest control can occur.

To minimize storage problems, buy only as much as you anticipate needing for the season. Keep records of previous usage to make good estimates of future needs.

## Reporting Requirements

Title III of the federal Superfund Amendments and Reauthorization Act of 1986 (SARA) is also called the Emergency Planning and Community Right-to-Know Act. This Act requires, among other things, the reporting of inventories of certain pesticides if the amount stored is greater than a “threshold planning quantity” (see Chapter 1, Pesticide Laws and Regulations.) It is good policy to inform your local fire department if you store chemicals. Chemical fires usually cannot be extinguished by ordinary means, and the smoke from the fire can be extremely hazardous to firefighters. The fire department must be properly prepared in the event of a chemical fire. For more information on these requirements, see Michigan State University Extension bulletin E-2173 or contact the MDNR Title III office at (517) 373-8481.

## DISPOSE OF PESTICIDES SAFELY

The pesticide user is responsible for proper disposal of pesticide wastes, such as unused chemicals and empty pesticide containers. In recent years, concern has been growing that improper disposal of pesticide wastes can create serious hazards for both humans and the environment. Empty pesticide containers are a hazard to curious children and animals. Improperly disposed of pesticides and rinse water can result in ground-water contamination and plant damage.

It makes good business sense to deal with pesticide wastes properly and safely. Plan carefully and observe the following guidelines:

- Avoid disposal problems associated with excess pesticide by mixing only the amount needed for one application or one series of applications needed to manage a given pest problem.

- Always read the label for disposal instructions.
- Clothing and protective equipment to be discarded, and contaminated soil or other materials used to clean up spills, should be considered pesticide waste and handled as such.
- Federal and state laws regulate the disposal of containers and other pesticide wastes. Anyone requiring assistance with pesticide disposal should contact the Michigan Department of Natural Resources (MDNR) Waste Management Division at (517) 373-2730.

## Cleaning and Disposing of Containers

Triple-rinsing or high-pressure rinsing (power-rinsing) allows glass, metal, plastic and even some heavy paper containers to be considered nonhazardous waste. It also saves money because each rinse captures pesticide residues from the sides and bottom of the container that can be included in the application and not wasted.

Properly rinse pesticide containers at the time they are emptied—residues can dry and become difficult to remove later.

To **triple-rinse**, wear protective clothing and follow these steps:

1. Allow the concentrate to drain from the empty pesticide container for 30 seconds.
2. Fill approximately 10 percent of the container volume with water, replace the lid and rotate the container so all the interior surfaces are rinsed.
3. Put the rinsewater into the spray equipment and use it as part of the application, allowing the container to drain for at least 30 seconds.
4. Repeat the procedure two more times.

Power-rinsing is an effective way to make a pesticide container nonhazardous. Power-rinsing requires the use of a special nozzle that directs high-pressure water into the container. Check with your local chemical dealer for availability. Studies have indicated that power-rinsing may be up to 300 percent more effective than triple rinsing and can take less time.

To **power-rinse**, wear protective clothing, especially gloves and goggles or face shield, and follow these steps:

1. Allow the concentrate to drain from the empty pesticide container for 30 seconds.
2. Push the pointed pressure-rinse nozzle through the bottom of the pesticide container while holding it over the spray tank or water system being treated.

3. Power-rinse the container for 30 seconds, allowing the rinsewater to drain into the spray tank or water system being treated.

4. Triple-rinse the container cap with a slower flow of water, capturing the rinsewater in the spray tank or water treatment system.

Triple- or power-rinsed containers that will be held for disposal at a later time should be marked to indicate triple- or power-rinsing has been done and the date. Pesticide containers that will not be recycled through a recycling facility or the dealer should be rendered unusable by breaking, puncturing or crushing. Never reuse pesticide containers. Keep all containers in the locked storage area until disposal, away from all possible contact with children and animals.

Disposal of triple-rinsed or power-rinsed containers in a sanitary landfill is permissible, but it is a good policy to check with your local solid waste authority before discarding pesticide containers there.

Whenever feasible, recycle triple- or power-rinsed containers. For information on recycling facilities, contact the MDNR Waste Management Division at (517) 373-2730 or the MDA at (517) 373-1087.

Commercial applicators should be aware of the current hazardous waste guidelines established under the federal Resource Conservation and Recovery Act (RCRA) as well as state hazardous waste statutes (Act 64) before disposing of pesticide wastes. Pesticide wastes classified as hazardous require special disposal and recordkeeping practices. The MDNR Waste Management Division, (517) 373-2730, can provide more information on the RCRA and your specific disposal responsibilities under the law.

**Follow disposal instructions on the label; seek assistance with disposal problems!**

## TRANSPORT PESTICIDES SAFELY

Once a pesticide is in your possession, you are responsible for its safe transport. Accidents can occur even when transporting materials a short distance. Do all you can to prevent a transport problem, but be prepared if an emergency should arise.

### Transport Vehicle

The safest way to carry pesticides is in the back of a truck. Flatbed trucks should have side and tail racks. Never carry pesticides in the passenger compartment of a vehicle: hazardous fumes may be released and spills may cause injury and be

impossible to remove from seats. If pesticides are transported in a station wagon, windows should be open and no one should be permitted to ride near the pesticides. Never carry pesticides in the same compartment with fertilizers, seed, food or feed—the risk of contamination is too high should a spill occur.

## Pesticide Containers

Inspect containers before loading to be sure all caps and plugs are tightly closed and legible labels are attached. Be sure the outside surfaces of the containers are not contaminated with pesticide. Secure containers to safeguard against spills or leaks that may result if the containers roll or slide.

Protect pesticides from temperature extremes during transport. In hot weather, for instance, the temperature inside the trunk of a car is always considerably higher than the temperature outside.

**Never** leave your vehicle unattended when transporting pesticides in an unlocked trunk compartment or open-bed truck. You are legally responsible if curious children or careless adults are accidentally poisoned by pesticides left unattended and exposed in your vehicle. Whenever possible, transport pesticides in a locked compartment.

**Never** eat, drink or smoke when handling pesticides, even if containers are intact and tightly sealed. Wash your hands thoroughly when you finish.

## PESTICIDE FIRE SAFETY

Pesticide products vary significantly in their flammability and storage hazard. Those requiring extra precautions bear the label statement, “Do not use or store near heat or open flame.”

To reduce fire hazards:

- Locate storage areas as far as possible from where people and animals live.
- Keep storage area locked at all times.
- Store combustible materials away from steam lines and other heating systems.
- Do not store glass containers in sunlight where they can concentrate heat rays and possibly explode or ignite.
- Keep a fire extinguisher approved for chemical fires in all storage areas.
- Notify the servicing fire company of the location and contents of the storage area. It may save firefighters lives and the lives of others if a fire occurs.

## **In the Event of a Pesticide Fire:**

- Clear all persons from the area to a safe distance upwind from the smoke and fumes.
- Call the fire department and inform the firefighters of the nature of the pesticides involved. Material Safety Data Sheets (MSDS), which provide technical and emergency information are available from chemical dealers.
- Firefighting personnel must bring and wear the proper protective clothing and equipment (especially respirators). Assume all

protective gear worn at the fire scene is contaminated and hazardous until it is washed.

- Be aware of the potential for explosion of overheated pesticide containers. Nearby containers should be moved or kept cool.
- The principal objective is to contain the fire and prevent contamination of surrounding areas. Use only as much water as is absolutely necessary. Avoid using heavy hose streams and build necessary dikes to prevent flow of contaminated runoff into lakes, ponds, streams, wells or sewers.

---

## Chapter 6 – Review Questions

**Write the answers to the following questions, and then check your answers with those in the back of this manual.**

1. A safe way to open a bag containing pesticides is to tear it open. True or False?
2. The recommended water pH for mixing most pesticides is between \_\_\_\_\_ and \_\_\_\_\_.
3. List some of the desirable characteristics of a pesticide storage area.
4. Pesticides should be stored in:
  - a. any convenient container.
  - b. their original containers.
  - c. containers too heavy for children to handle.
  - d. any container as long as it is tagged with the name of the contents.
  - e. none of the above.
5. Pesticides should be stored on metal shelving because metal will not absorb spilled pesticides and is easier to clean than other surfaces. True or False?
6. Why should you keep an inventory of pesticides and mark purchase dates on the container?
7. List some of the clues that show a pesticide has deteriorated.
8. What is the best way to get rid of a registered pesticide?
9. How do you triple-rinse a container?
10. Whom do you contact for assistance with disposal problems?
11. If a poisoning incident occurs from a pesticide you are transporting, you will not be liable. True or False?

12. What is the safest way to transport pesticides?

15. List three precautions you could take to prevent fire hazards.

13. You are legally responsible if a curious child or adult is accidentally poisoned from pesticides left unattended. True or False?

14. What types of pesticides are most likely to be flammable and have the following statement on their label: "Do not use or store near heat or open flame?"

16. What should you do first in the event of a pesticide fire?

---

# CHAPTER 7

# THE PESTICIDE LABEL

## LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Distinguish among the terms “common name,” “chemical name” and “brand name” and know which to use to most accurately identify a pesticide product.
- Explain the meaning of “restricted use” classification and explain where to look for the classification on pesticide labeling.
- Interpret the signal words (and symbols) on pesticide labeling.
- Know the types of precautionary statements on pesticide labeling.
- Explain the pesticide user’s responsibility to follow use directions.
- Know what Material Safety Data Sheets are and where to obtain them.

---

One of the more important tools for safe and effective use of pesticides is the product label. Pesticide manufacturers are required by law to put certain information on the label. Not following that information can result in a pesticide accident and legal action against the violator. Labels are legal documents that provide directions on how to transport, mix, apply, store, and dispose of a pesticide product or its container. This chapter will teach you how to read and apply the information on pesticide labels.

## PARTS OF THE LABEL

Some labels are very easy to understand; others are complicated. It is the user’s responsibility to read and understand the label before buying, using, storing or disposing of a pesticide. To help you better understand labels, each of the label components will be discussed in this section. The numbers preceding the descriptions correspond to the numbered parts of the sample label of NO PEST at the end of this chapter.

### 1. Trade, Brand or Product Names

Every manufacturer has trade names for its products. Most companies register each trade name as a trademark and will not allow any other company to use that name without permission. Different trade names are used by different

manufacturers, even though the products contain the same active ingredient. The brand or trade name is on the front panel of the label and is the one used in advertisements and by company salespersons.

The brand name often indicates the type of formulation and the percent active ingredient. For example, Sevin 50 WP is a brand name of an agricultural product; Sevin is the registered trade name and the formulation is a wettable powder containing 50 percent active ingredient. This product is formulated for agricultural purposes and is not registered for use on animals.

### 2. Ingredient Statement

Every pesticide label must list every active ingredient and the percentage of it in the container. Inert ingredients are not usually named, but the label must show what percentage of the total contents they make up. The ingredient statement must list the official chemical and common names of the active ingredients. Let’s discuss an example:

Sevin 50 WP  
Active ingredient:  
carbaryl (1-naphthyl N-methyl carbamate)....50%  
inert ingredients.....50%

The **chemical name** is the complex name that identifies the chemical components and structure of the pesticide. This name must be listed in the ingredient statement on the label. For example, the chemical name of Sevin is 1-naphthyl N-methyl carbamate.

Because chemical names are usually complex, many chemicals are given a shorter **common name**. Only those common names officially accepted by the EPA may be used in the ingredient statement on the pesticide label. The official common name is usually followed by the chemical name in the list of active ingredients. The common name for Sevin is carbaryl. By purchasing pesticides according to the common or chemical names, you will be certain of getting the right active ingredient, no matter what the brand name or formulation.

Recognize that even though you have found the correct active ingredient, the product must be labeled for use on animals or it cannot be safely used on animals for pest control. A single active ingredient may be formulated several ways. Only those formulations specifically designated for use on animals can be safely and legally used on animals.



When treating for pests, use only products labeled for use on animals!

### 3. Use Classification Statements

Every pesticide product is classified by the EPA as either restricted use or unclassified/general use. Every pesticide product classified as restricted use must carry this statement in a

prominent place at the top of the front panel of the pesticide label:



### 4. Type of Pesticide

The type of pesticide is usually listed on the front panel of the pesticide label. This short statement indicates, in general terms, what the product will control. Examples:

- Insecticide for control of certain insects.
- Herbicide for control of woody brush and weeds.
- Fungicide for control of plant and animal pathogens.

### 5. Net Contents

The front panel of the pesticide label shows how much product is in the container. This is expressed as pounds or ounces for dry formulations or as gallons, quarts, or pint for liquids. Liquid formulations may also list the pounds of active ingredient per gallon of product.

### 6. Name and Address of Manufacturer

The law requires that the manufacturer or formulator of a product put the name and address of the company on the label. This tells you who made or sold the product.

### 7. Registration Numbers

An EPA registration number (e.g., EPA Reg. No. 9999-000-00000) must appear on all pesticide labels. This indicates that the pesticide product has been registered and its label approved by the EPA. In cases of special local needs, pesticide products may be approved for use in a specific state. These registrations are designated, for example, as EPA SLN No. MI-860009. In this case, SLN indicates "Special Local Need" and MI means that the product is registered for use in Michigan.

<b>TOXICITY</b>	<b>HIGH</b> May Cause Death! See a physician immediately.	<b>MODERATE</b> Possible Serious Illness! See a physician if symptoms persist.	<b>LOW or SLIGHT</b> May Cause Illness! See a physician if symptoms persist.
<b>INDICATION ON LABEL</b>	<b>DANGER POISON</b> 	<b>WARNING</b>	<b>CAUTION</b>

The words **DANGER** and **POISON**, **WARNING** or **CAUTION** indicate the toxicity level.

## 8. Establishment Numbers

An EPA establishment number (for example, EPA Est: No. 9999-TX-1) must also appear on the pesticide label. It identifies the facility that produced the product in case a problem arises or the product is found to have been adulterated in any way.

## 9. Signal Words and Symbols

Every pesticide label must include a signal word. This important designation gives the user an indication of the relative toxicity of the product to humans and animals. Toxicity is one factor you should consider when choosing a pesticide. The signal word must appear in large letters on the front panel of the pesticide label along with the statement, “Keep Out of Reach of Children.” The following signal words may be found on pesticide labels.

- **DANGER-POISON, SKULL AND CROSSBONES** – These words and symbol must appear (in red letters) on all products that are highly toxic by any route of entry into the body. “Peligro,” the Spanish word for “danger,” must also appear on the label.
- **DANGER** – Products with this signal word can cause severe eye damage or skin irritation.
- **WARNING** – This word signals that the product is moderately toxic orally, dermally, or through inhalation, or causes moderate eye or skin irritation. “Aviso,” the Spanish word for “warning,” must also appear on the label.
- **CAUTION** – This word signals that the product is slightly toxic orally, dermally or through inhalation, or causes slight eye or skin irritation.

Chapter 5, Pesticides and Human Health, further describes signal words.

## 10. Precautionary Statements

All pesticide labels contain additional statements to help applicators decide what precautions they should take to protect themselves, their employees and other persons (or animals) that could be exposed. Sometimes these statements are listed under the heading, “**Hazards to Humans and Domestic Animals.**” They may be contained of several sections:

**Routes of entry statements** – The statements which immediately follow the signal word, either on the front or side panels of the pesticide label, indicate which route or routes of entry—mouth, skin, lungs—are particularly hazardous and need protection. Many pesticide products are hazardous by more than one route, so study these statements carefully. A **DANGER** signal word followed by “**May be fatal if swallowed or inhaled**” gives you a far different warning than **DANGER** followed by “**Corrosive—Causes eye damage and severe skin burns.**”

**Specific action statements** – These statements usually follow immediately after the route of entry statements. The specific action statements help prevent pesticide poisoning by recommending necessary precautions and protective clothing and equipment. These statements are directly related to the toxicity of the pesticide product (signal word) and the routes of entry.

**Protective clothing and equipment statements** – Pesticide labels vary in the type of protective clothing and equipment statements they contain. Many labels carry no statement at all. The best way to determine the correct type of protective clothing and equipment is to consider the signal word, the route of entry statements, and the specific action statements on the label.

## 11. Statement of Practical Treatment

This section lists first aid treatments recommended in case of poisoning.

All **DANGER** labels and some **WARNING** and **CAUTION** labels contain a note to physicians describing the appropriate medical procedure for poisoning emergencies and may identify an antidote. **The label should always be available for emergencies. In the event of a pesticide poisoning, take the label to the hospital with you.**

## 12. Environmental Hazards

Pesticides can be harmful to the environment. Some products are classified restricted use because of environmental hazards alone. Watch for special warning statements on the label on hazards to the environment.

**Special toxicity statements** – If a particular pesticide is especially hazardous to wildlife, it will be stated on the label. For example: “This product is highly toxic to bees,” or “This product is toxic to fish.”

These statements alert pesticide users to the special hazards posed by use of the product. They should help applicators choose the safest product for a particular job and remind them to take extra precautions.

**General environmental statements** – Some of these statements appear on virtually every pesticide label. They are reminders to follow certain common sense actions to avoid contaminating the environment. The absence of any or all of these statements does not indicate that you do not need to take adequate precautions. Sometimes these statements follow a “**specific toxicity statement**” and provide practical steps to avoid harm to wildlife. An example of a general environmental statement: “Do not apply when runoff is likely to occur.”

## 13. Physical or Chemical Hazards

This section of the label describes any special fire, explosion or chemical hazards the product may pose. For example: “Flammable—Do not use, pour, spill or store near heat or open flame. Do not cut or weld container.”

**Hazard statements** (hazards to humans and domestic animals, environmental hazards, and physical or chemical hazards) are not located in the same place on all pesticide labels. Some labels group them under the headings listed above. Other labels may list them on the front panel beneath the signal word. Still other labels list the hazards in paragraph form somewhere else on

the label under headings such as “Note” or “Important.” Before use, examine the label for these statements so you can handle the product knowledgeably and safely.

## 14. Restricted Entry Interval Statement

Some pesticide labels contain a restricted entry interval precaution. This statement tells how much time must pass before people can reenter a treated area without appropriate protective clothing and equipment. If no restricted entry statement appears on the label or none has been set by your state, then all unprotected workers must wait at least until sprays have dried or dusts have settled before reentering without protective equipment. That is the minimum legal restricted entry interval. For the sample product label we have included in this chapter, the treated animal should not be handled by anyone until the application has dried, or the person should be wearing all the appropriate personal protective equipment.



Read the label!

## 15. Directions for Use

These instructions are the best way to find out how to apply the product. The use instructions will tell you:

- The host the product is intended to protect.
- The proper equipment to be used and mixing instructions.
- How much to use (rate) and how often to apply.
- Compatibility with other often used products.
- Where and when to apply the material.

Failure to follow the instructions on a pesticide label can result in a serious pesticide accident and constitutes a legal violation subject to civil or criminal prosecution. Remember, the label is a legal document. The user is liable for personal injury, crop damage or pollution that occurs through misuse of a pesticide.

Directions for storage and disposal will also be provided.

## 16. Regulations

By law, the pesticide label must contain information on how the applicator must comply with the following regulations if the pesticide falls under the stipulation of the particular regulation:

### SARA Title III Law Endangered Species Act Worker Protection Standards

For specific information on each of these regulations, see Chapter 1, Pesticide Laws and Regulations. It is advisable to obtain original copies of these documents to understand their contents thoroughly.

## ADDITIONAL PESTICIDE INFORMATION – MSDS

In addition to pesticide labels, information about a particular pesticide is printed on a Material Safety Data Sheet (MSDS). These forms include information about the pesticide such as medical conditions that it may aggravate, whether it is carcinogenic and what are its primary routes of entry. The MSDS is available from chemical dealers and dated to help you determine if the information is current.

### 3 RESTRICTED USE PESTICIDE

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

**Chemco**

**1 NO PEST**

**Insecticide 4**

**SPONGE-ON DIP FOR DOGS**

**2 ACTIVE INGREDIENT:**  
N-(Mercaptomethyl) phthalimide S-(O, O-Dimethyl phosphoro-dithioate)  
.....11.60%  
**INERT INGREDIENTS:** ..... 88.40%  
Total 100%

**5** \*Contains aromatic petroleum solvent

**7** 4 FL.OZ.(118 ml)

EPA Reg. No. 9999-000-00000 **8** EPA Est. 9999-TX-1

#### **10** PRECAUTIONARY STATEMENTS

**HAZARD TO HUMANS AND DOMESTIC ANIMALS-WARNING:** Do not get in eyes, on skin or clothing. Harmful if swallowed, inhaled or absorbed through skin. Use only in well ventilated areas. Applicators must wear long-sleeved shirt, long pants, elbow-length waterproof gloves, waterproof apron and unlined, waterproof boots. Wash all contaminated clothing with soap and hot water before reuse. Wash thoroughly before eating, drinking or using tobacco. Do not use on animals simultaneously or within a few days before or after treatment with or exposure to cholinesterase-inhibiting drugs, pesticides or chemicals. Do not use this pesticide on sick, old or debilitated pets. Improper dilution of this product could cause serious injury to dogs.

#### **12** ENVIRONMENTAL HAZARDS

This pesticide is toxic to birds and extremely toxic to fish. Do not apply directly to water. Do not contaminate water by cleaning of equipment or disposal of waste. This product is highly toxic to bees.

**11 STATEMENT OF PRACTICAL TREATMENT:** If in eyes, rinse immediately with plenty of water, contact a physician immediately if irritation persists. If on skin, wash promptly with soap and water. Remove contaminated clothing. If swallowed, call a physician or poison control center immediately. Do not induce vomiting. If inhaled, remove victim to fresh air. Apply artificial respiration if necessary.

**NOTE TO PHYSICIAN/VETERINARIAN:** NO PEST is an organophosphorus insecticide and cholinesterase inhibitor. Atropine is antidotal. 2-PAM is also antidotal and may be administered with atropine. Usual symptoms of organophosphorus in man include headache, blurred vision, weakness, nausea, discomfort in chest, vomiting, abdominal cramps, diarrhea, salivation, sweating and pinpoint pupils. Usual symptoms in animals include salivation, labored breathing, ataxia and pinpoint pupils.

**13 PHYSICAL OR CHEMICAL HAZARDS:** Do not use or store near heat or open flame. Protect from temperatures below 20 degrees F.

**15 DIRECTIONS FOR USE –** It is a violation of federal law to use this product in a manner inconsistent with its labeling. **Fleas, Ticks and Sarcoptic Mange:** Mix 1 oz. (2 tsp.) NO PEST with 1 gal. water. Dip dog until skin is wet, allow to shake dry. Do not rinse. Reapply as necessary but not more often than every 7 days. Do not treat dogs under 8 weeks of age.

**Storage & Disposal:** Store in original container, away from children. Do not contaminate water, food or feed by storage or disposal. Do not reuse container. Rinse thoroughly before discarding in trash.



**KEEP OUT OF REACH OF CHILDREN**  
**9 WARNING**

READ ALL DIRECTIONS AND PRECAUTIONS BEFORE USING

See back panel for Note to Physician/Veterinarian

Sold by Chemco Corporation-East Lansing, MI 48823

**6** For information, call 1-800-999-0000



---

## Chapter 7 – Review Questions

Write the answers to the following questions and then check your answers with those in the back of this manual.

1. Labels are legal documents. True or False?
2. Regardless of the signal words they bear, all pesticide labels must carry the words, “**Keep Out of Reach of Children.**” True or False?
3. The skull and crossbones symbol must appear on every pesticide label. True or False?
4. Which signal word(s) on a pesticide label would indicate that the product is highly toxic to humans?
  - a. “WARNING”
  - b. “CAUTION”
  - c. “Keep Out of Reach of Children”
  - d. “DANGER-POISON”
5. Labels should be removed from pesticide containers and kept in a notebook so they remain clean and legible. True or False?
6. A certain active ingredient has only one technical chemical name and one accepted common chemical name, but it may be in products with several different trade/brand names. True or False?
7. What are Material Data Safety Sheets and where can you obtain them?
8. Should a face shield or goggles be worn when handling “NO PEST?” Yes or No?
9. If a person accidentally swallows several mouthfuls of “NO PEST” concentrate, should he/she be immediately administered Syrup of Ipecac to induce vomiting? Yes or No?
10. Regardless of the container material (glass, metal or plastic), all empty “NO PEST” containers should be:
  - a. burned.
  - b. punctured.
  - c. reused.
  - d. triple- or power-rinsed.
  - e. saved.
11. Containers of “NO PEST” can be kept in the kitchen as long as the storage area is locked. True or False?
12. Could use of this product present a hazard to any wildlife or other nontarget animals? Yes or No? List three groups of animals of particular concern:
  - 1.
  - 2.
  - 3.
13. After treating a dog with “NO PEST,” it should remain on the animal for 5 minutes and then be thoroughly rinsed off. True or False?

---

# CHAPTER 8

# FLEAS

## LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Identify a flea and describe its appearance.
- Explain the life cycle of fleas.
- Know which stages of the flea live on the animal and which do not.
- Describe the reasons that fleas are pests to animals.
- Understand how flea bite dermatitis develops and affects the animal.
- Develop an integrated flea management program.
- Understand and follow all precautions for human and animal safety when selecting and using flea control products.
- Explain the importance of treating the animal as well as the animal's environment when controlling flea populations.
- List the components of an effective flea larvae control program.
- Explain the importance of regular sanitation in controlling fleas.

---

## FLEA LIFE CYCLE

Fleas are insects of the order Siphonaptera (meaning siphon-like mouth and no wings). They are very small (2 to 4 mm in length), brown and flattened from side to side. Flea eggs are glossy white and oval. Immature fleas (larvae) are hairy and maggot-like in appearance. There are three instars or developmental stages of flea larvae, beginning with the larva that hatches from the egg. The second instar molts, or sheds the skin, and emerges out of the first instar. The third instar flea larva does the same, emerging from the second instar skin. With each molt, the flea larva grows larger. The third instar flea larva spins a silken cocoon and covers the cocoon with material from its environment. It molts inside of the cocoon to become a pupa. After a period of development the adult flea emerges from the pupa. The entire life cycle of a flea, from egg to adult, may take as few as 12 days or may last as long as 140 days, depending on temperature. Also, fleas may "rest" in the pre-emerged adult stage, inside the cocoon, if no hosts are available for the adults to jump onto.

Though there are over 2,000 species of fleas, the life cycle is similar in almost all of them. Adult

fleas obtain a blood meal from their animal hosts. They do not utilize any other kind of food. Thus, adult fleas are ectoparasites. In contrast, flea larvae live in the environment near the host animal but do not live on the animal. So, flea larvae are not ectoparasites.

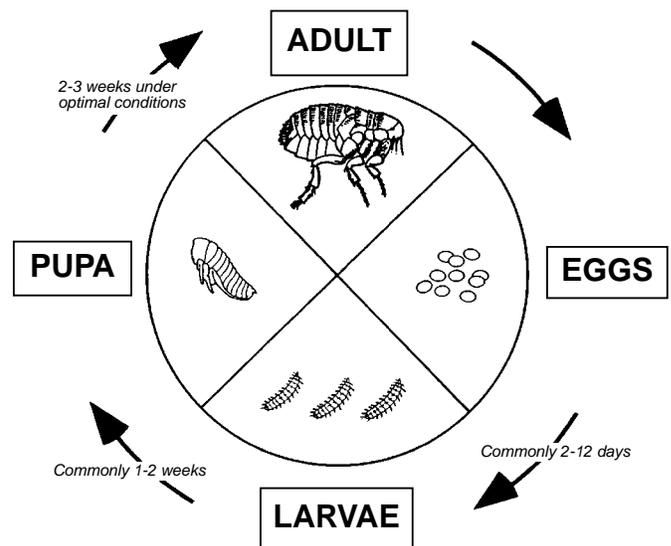


Figure 8.1 Flea Life Cycle

The fleas of primary importance to domestic animals, whether companion or food animals, are the dog flea, cat flea and sticktight flea. Table 8.1 lists the scientific and common names of some fleas and shows which animals commonly serve as their hosts. Dog and cat fleas are intermediate hosts for dog tapeworms.

## DOG AND CAT FLEAS: LIFE HISTORY

In many parts of the United States, the dog flea has been replaced by the cat flea as the most commonly found flea on both dogs and cats. These fleas are so similar in appearance and biology that we can treat them as basically the same. However, the scientific names are different. The dog flea is called *Ctenocephalides canis*, and the cat flea is called *Ctenocephalides felis* (“dog flea” and “cat flea” will do).

**Table 8.1 Common Fleas Affecting Domesticated Animals in the U.S.**

Host Animal	Flea species	Common Name
Dog	<i>Ctenocephalides canis</i>	Dog flea
Cat	<i>Ctenocephalides felis</i>	Cat flea

The cat flea is an extremely important pest of these animals. In instances of heavy infestation when many fleas are present on an individual animal, the blood loss can be great and lead to poor animal health. Young animals may become anemic (weakened by blood loss) from heavy, regular feeding by fleas. Kittens and puppies can die from heavy infestations of fleas. Flea bites cause animals to itch. The animals scratch, adding to the irritation of their skin.

Additionally, many dogs and cats develop flea bite dermatitis, an allergic condition that can be brought on by a single flea bite in an allergic or sensitized animal. In extreme conditions, animals develop “hot spots” (or “acute moist dermatitis”) where they continually scratch at highly inflamed sites on the skin, creating conditions for bacterial infection. A hot spot is painful to the animal and may exude pus.

Dog and cat fleas have very similar life cycles. (Figure 8.1.) The adult fleas spend virtually all of their lives on the host. They mate on the host and both male and female fleas feed on blood by biting their host. The fleas feed daily and the female fleas lay eggs that drop from the host animal into the environment. A female lays a few eggs each

day and several hundred over the course of her life. Flea eggs accumulate in areas where the host spends most of its time. In addition, the fleas defecate small pellets of digested blood into the host hair. These feces also drop off into the environment. A flea comb will often gather these feces and flea eggs at the base of the tines. This provides a good sign of flea infestation on dogs or cats.

Flea larvae occur indoors and outdoors, wherever the eggs have fallen off of the host. In houses, flea larvae live in carpeting, furniture, animal bedding and other protected areas with high humidity. Flea larvae can also live outdoors in areas where animals spend time (such as under porches, in dog houses, etc.). Because flea larvae depend on the fecal pellets of dried blood produced by the adult fleas for food, larvae cannot survive in places that do not get a steady supply of adult flea feces. Therefore, flea larvae do not live in lawns or other outdoor areas unless the pet frequents those areas enough to provide food for the larvae.

Adult fleas inside the cocoon, called pre-emerged fleas, can stay in that condition for weeks to months if no host is available for them. However, when disturbed by the presence of a host (such as passing vibrations, carbon dioxide from exhaled breath or other factors), the pre-emerged fleas activate, leave the cocoon and jump onto the host. This is why it is possible to return to a house or apartment that has been empty for months and find it full of fleas.

## FLEA MANAGEMENT

Management of fleas on dogs and cats requires an integrated approach. Both the host animal and the environment must be treated at the same time to be effective. Control of fleas on the animal generally requires the use of insecticides. Although flea combs can remove some fleas, combing is a better method for detecting fleas than for removing them from the pet.

**Insecticides.** A range of insecticides in the organophosphate, carbamate, pyrethrin and pyrethroid categories are available for flea control on the animal. Greyhounds and cats are more sensitive to insecticide products than most dogs. Read all insecticide labels, follow all precautions and dose directions. Consult a veterinarian if you have questions. The pyrethrins and pyrethroids have the lowest mammalian toxicity. These insecticides come in formulations such as shampoo, dust and powder, mousse, aerosol and non-aerosol mist or spray, dip, spot-on, roll-on and collar. Organophos-

phate drugs are also available, by prescriptions from veterinarians, for oral use. Some on-animal formulations contain insect growth regulators that kill flea eggs on the animal.

**Treating the animal.** When treating an animal, the applicator must take precautions to protect him- or herself from contact with the insecticide. All personal protective equipment listed on the label must be worn. As a minimum, chemical-resistant gloves, apron and goggles should be worn while mixing insecticides and during application to prevent insecticide contact with the skin. The working area should be appropriate for containment of the pesticide and should be resistant to caustic materials. A stainless steel preparation table and stainless steel or ceramic tub have these qualities.



Mixing insecticides before shampooing an animal requires protective equipment and a good working surface.



Protective equipment (gloves, apron, goggles) should be worn during insecticide applications onto animals.



If expression of anal glands is required, this procedure should be done before the application of the insecticide occurs. This will minimize the contact of interior mucosal membranes with the insecticide.

If an animal is to be treated for other conditions besides fleas, such as expression of anal glands, then these procedures should be done before the insecticide application to minimize insecticide contact with interior mucosal membranes.

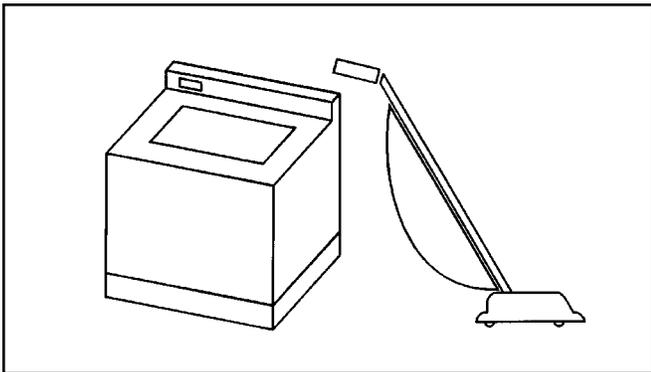
The insecticides used for flea control vary widely in toxicity and efficacy. Considerations for selecting a formulation include the size and weight of the animal, as well as the species. For example, cats groom themselves more than dogs and are more likely to ingest an insecticide and become poisoned by licking the residue from their fur. Cats are more sensitive to organophosphate insecticides than are dogs. Read and follow all label directions. Kittens and puppies, because of their smaller size, require a lower dose than do adult animals. Young animals may also require treatment with insecticides of lower toxicity than adult animals. Pregnant or nursing animals may

be sensitive to certain insecticides. Veterinarians should have accurate information on insecticides and their use for flea control on animals. The insecticide label contains accurate information on how a particular formulation of an insecticide should and should not be used. **READ THE LABEL BEFORE OPENING THE CONTAINER!**

Greyhounds are a very chemical-sensitive species. Do not attach flea collars or flea-killing medallions on these dogs. Do not use chlorpyrifos, DDVP, methoxychlor or malathion on greyhounds.

**Treating the animal's environment.** The other important part of an integrated flea management program is to control larval fleas in the environment or larval habitat away from the animal. This can be achieved mechanically or physically and with insecticides.

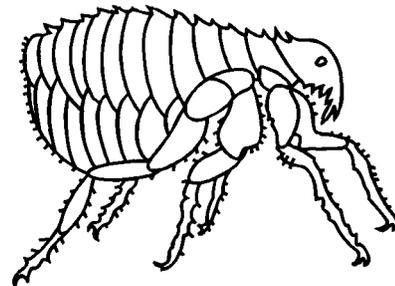
Mechanical or physical control of flea larvae requires removal and laundering of animal bedding and thorough cleaning of areas frequented by the animal. Using a vacuum with a beater bar and immediately disposing of the waste bag effectively eliminates up to half of the larvae and eggs in carpet. Do not put insecticides in the vacuum cleaner bag. This is an illegal use of the products and can harm you, your family and pets by creating dusts or fumes that could be inhaled. After vacuuming, dispose of the vacuum bag to avoid a hatch of fleas eggs inside it.



**Launder animal bedding and thoroughly clean areas the animal frequents. Dispose of the vacuum waste bag after every cleaning.**

Carpet shampooing rids the carpet of blood feces, an important food for the larvae, and may also remove eggs and larvae. In outdoor areas, cleaning up the places where animals like to rest reduces eggs and larvae and removes blood pellets. In yards and kennels, flea larvae will be found in cracks at wall-floor junctions and in floor crevices. These areas must be thoroughly cleaned and then maintained to prevent another infestation.

Chemical control of flea larvae can be achieved with insecticides. Organophosphate, carbamate, pyrethrin, pyrethroid and growth regulator (hormone mimic) insecticides and certain minerals are available for flea control in the environment. These insecticides are formulated as coarse sprays, foggers and dusts or are microencapsulated. All but the growth regulators kill flea larvae on contact. Insect growth regulators prevent flea larvae from developing to the adult stage. Growth regulators may also inhibit egg hatching. A good flea larval control program will incorporate sanitation, contact insecticides and growth regulators for good results.



Flea management requires patience, time and careful planning. Vacuuming and cleaning areas frequented by dogs and cats should be a regular, routine part of house cleanliness and pet care. The same applies to kennels. If an infestation occurs, insecticide applications on the animals or in the environment may have to be repeated according to the intervals listed on the label, depending on the efficacy of the treatments. The need for retreatment and time intervals between insecticide treatments will vary with the kind of insecticide and the formulation.

Successful flea control will not happen if only one approach, such as dipping the dog, is used. The animal and the environment in which it lives must be treated simultaneously, and that treatment must be combined with regular sanitation efforts. Read all product labels carefully. Do not overexpose your pet by combining too many treatments at one time, such as a collar, a shampoo and a dust. Pesticides have a cumulative effect. Be aware of each product's toxicity and do not endanger yourself or the animal by using excessive amounts of any one product or by combining products.

When using insecticides for flea control, remember that the applicator and the animal owner can be exposed to the insecticides at several times in the management process. The label may call for the use of gloves and other protective equipment



**An application of ophthalmic ointment to the eyes of the animal prior to insecticide treatment helps prevent eye irritation.**

during application and suggest the pet not be handled with unprotected hands until the treatment dries. Also, certain parts of the pet's body (such as the eyes) may be sensitive to the insecticides and must be shielded during application.

The applicator should follow label directions and application guidelines carefully to minimize exposure during and after application. When using flea "bombs" (aerosol cans with a self-releasing mechanism), follow all the precautions and remove the pets from the area being treated. Using excessive rates is illegal and can result in fires and even explosions.

---

## Chapter 8 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. Kittens and puppies can die from heavy infestations of fleas. True or False?
2. What is “flea bite dermatitis”?
3. How does a flea infestation lead to the development of “hot spots” (or “acute moist dermatitis”) on animals?
4. Dogs are the only hosts for dog fleas and cats are the only hosts for cat fleas. True or False?
5. How many eggs might a female flea lay in a day? How many eggs would she lay in her life?
6. Flea eggs can accumulate on the host as well as in areas where the host animal spends most of its time. True or False?
7. Flea larvae feed on:
  - a. fur.
  - b. animal dander.
  - c. lawn grasses.
  - d. adult flea fecal pellets of blood.
  - e. all of the above.
8. What are two important parts to an integrated flea management program?
9. Cats are more sensitive to organophosphates than dogs. True or False?
10. Why should you never put insecticides into vacuum bags?
11. How do insect growth regulators control fleas?
12. Releasing excessive rates of flea “bombs” can result in \_\_\_\_\_.

---

## CHAPTER 9

# MITES AND TICKS

### LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Describe how mites and ticks differ from insects.
- Understand the ways that mites can negatively affect animal health.
- Explain what mange is and how it occurs.
- Explain the generalized life cycle of mites.
- List several mites that affect animals.
- Describe integrated programs for controlling mites and ticks.
- Understand the basic life cycles of ticks.
- Describe the appearance of a tick.
- List some of the important tick pests of animals.

---

### MITES

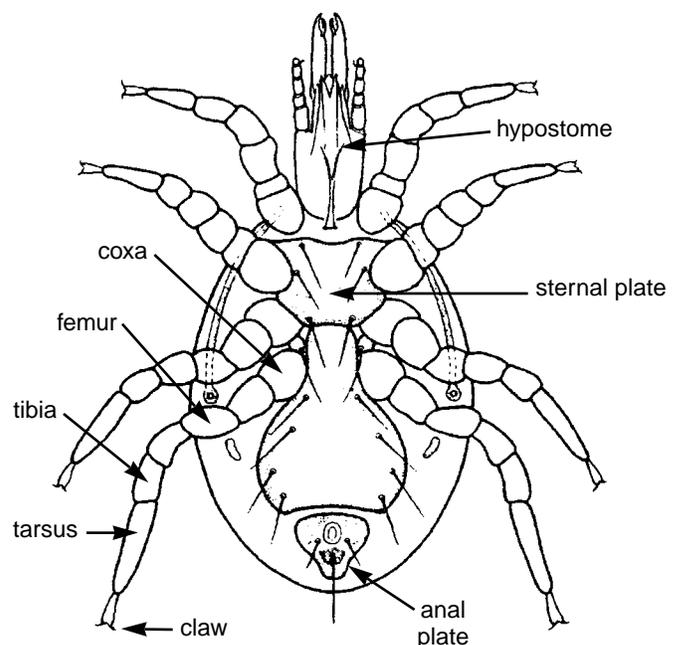
There are more than 200 families of mites and many thousands of species. Most mites are free-living and feed on plant juices or prey upon other arthropods. Some mites have evolved to become important ectoparasitic pests of animals. Some species of mites have even become endoparasites, by invading the ears, bronchi and lungs, nose and other tissues of animals. More than 50 species of mites live on or in the bodies of domestic animals.

In general, mites can affect the health of animals in four ways by:

- Damaging tissues and causing dermatitis.
- Causing blood or body fluid loss.
- Causing allergic reactions.
- Creating conditions for secondary bacterial infection.

The generalized veterinary term for an infestation of mites in an animal is acariasis (pronounced ack-uh-RYE-uh-sis). Mange or scabies is one of the most common problems that mites cause in animals. Mange is a deterioration of the skin's condition, leading to hair or feather loss, skin discoloration and, in severe cases, lethargy and weakness. The USDA defines scabies and mange as "any skin condition of man or animals associated with a mite; scabies is a particularly serious, debilitating, reportable mange condition."

Mites are tiny arthropods, usually less than 1 mm in size, and can be difficult to see and identify without the aid of a strong microscope or at least a hand lens. Figure 9.1 shows a schematic view of the general anatomy of a mite. Note that the feeding apparatus of a mite is called the hypostome. It contains the chelicerae and the



**Figure 9.1** General anatomy of a mite.  
Source: Centers for Disease Control.

paired palpi (singular, palpus). The legs are segmented, and each joins the body at the coxa. The body of a mite consists of various hard plates of cuticle connected together by softer cuticle.

Mites breathe directly through their cuticle, in the smaller species, or through pores in the cuticle (called stigmata), which are connected to internal air tubes. Mites may or may not have simple eyes. Although the figure does not show it, mites are often rather hairy looking because of the presence of spines. Mites can vary greatly from this generalized body design, as figures and descriptions given below will demonstrate.

## Life Cycle

The generalized life cycle of mites can be described as follows. Mites mate and the females lay eggs. The eggs hatch and six-legged **larvae** emerge. These larvae feed and molt to the eight-legged **nymph** stage. Later, after feeding, the nymphs molt and become **adult male** or **female** mites. This entire life cycle can take as little as eight days to as long as four weeks, depending on the species of mite, and the temperature and humidity.

**Table 9.1 Common ectoparasitic mite pests affecting animal health in the U.S.**

Host Animal	Common Name	Scientific Name	Tissue Affected	Mite Activity	Pathological Condition
<b>Cat</b>	Follicle mite	<i>Demodex cati</i>	hair follicle	live in hair follicles,	demodetic mange
	Notoedric scabies mite	<i>Notoedres catis</i>	skin	mites dig tunnels, live in skin	notoedric scabies,, mange
	Ear mite	<i>Otodectes cynotis</i>	skin surface in ear canal	live in ear canal, feed on skin debris	ear mite infestation
	Cat Fur mite	<i>Cheyletiella blakei</i>	skin	punctures skin and sucks lymph	scaly dermatitis
<b>Dog</b>	Follicle mite	<i>Demodex canis</i>	hair follicles	live in hair follicles and feed on sebum	demoectic mange
	Sarcoptic mange mite	<i>Sarcoptes scabiei</i> var. <i>canis</i>	skin	mites dig tunnels, live in skin	scabies, mange
	Ear mite	<i>Otodectes cynotis</i>	skin surface in ear canal	live in ear canals, feed on skin debris	ear mite infestation
	Dog fur mite	<i>Cheyletiella parasitivorax</i>	skin	punctures skin and sucks lymph	scaly dermatitis
<b>Rabbit</b>	Notoedric scabies mite	<i>Notoedres cati</i>	skin	mites dig tunnels, live in skin	notoedric scabies, mange
	Ear mite	<i>Psoroptes cuniculi</i>	ear canal	live in skin or under scabs	psoroptic ear mange
	Rabbit fur mite	<i>Cheyletiella yasguri</i>	skin	punctures skin and sucks lymph	scaly dermatitis
<b>Caged Birds</b>	Chicken mite	<i>Dermanyssus gallinae</i>	roosts (free-living)	feeds on blood through skin	dermatitis, blood loss
	Northern fowl mite	<i>Ornithonyssus sylviarum</i>	skin, feathers	feeds on blood through skin	dermatitis, blood loss
	Scaly-leg mite	<i>Knemidokoptes mutans</i>	skin	burrow beneath epidermal scales	scaly leg lesions
	Depluming mite	<i>Knemidokoptes laevis</i> var.	base of feathers	burrow beneath epidermal scales	skin irritation, feather loss

## MITE PESTS OF ANIMALS

Table 9.1 lists the common mite pests of domestic animals. In general, the important mites that can be controlled with insecticides (or more properly, **miticides**) include the following groups:

- Burrowing mange mites (including the sarcoptic mange mites, notoedric mange mites and knemidocoptic mange mites).
- Non-burrowing mange mites (the psoroptid mange mites).
- Ear mites (psoroptid ear mites and otodectic ear mites).
- Demodectic or hair follicle mites.
- Fur mites (cat, dog and rabbit fur mites).

These mites cause adverse skin conditions on their host animals.

### Burrowing Mange Mites

Sarcoptic mange mites cause sarcoptic mange. Sarcoptic mange mites belong to one species, *Sarcoptes scabiei*, with host-adapted varieties that do not cross-infest other animals. This means they usually infest only one kind of animal host. There are at least seven varieties infesting dogs, horses, sheep, goats, swine and foxes. Cats, rabbits and fowl are not affected by sarcoptic mange mites.

The life cycle of sarcoptic mange mites is similar on different host animals. The mated female mite burrows into the skin and forms a tunnel over an inch deep where she feeds on lymph fluid (a clear body fluid). She lays 40 to 50 eggs in the burrow and then dies. Tiny, six-legged larvae hatch from the eggs, leave the female's burrow and wander on the animal's body. The larvae form new pocket-burrows in the skin, where they feed and molt to two succeeding nymphal stages. The nymphs may also move about and make new tunnels. Nymphs

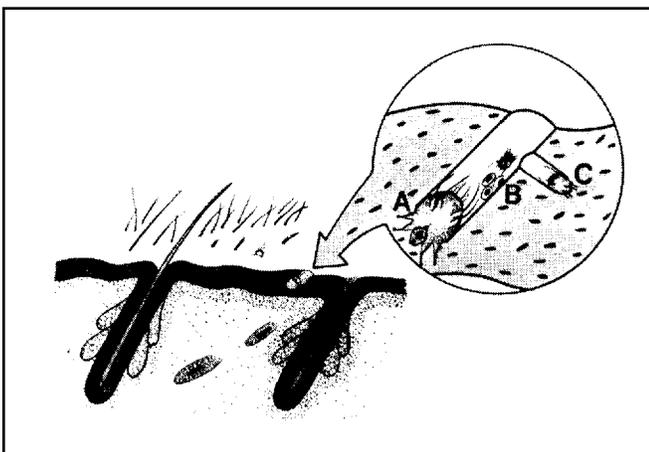


Figure 9.2 Sarcoptic mange mite life cycle: Adult (A) lays eggs (B), which develop into immature nymph stages (C).

molt and become adult males or females, which mate. Figure 9.2 shows a sarcoptic mange mite life cycle. If the mites fall or drop off the host animal, they are susceptible to dehydration (loss of water) and usually die within a few days.

Sarcoptic mange mites, because of their burrowing behavior and feeding, cause intense itching and dermatitis. Affected animals may scratch so heavily that liquid exudes from the affected skin, causing skin crusts and skin cracking and thickening. Secondary infection is common in scratched areas.

Though all parts of an animal's body may be affected, usually the less hairy areas become infested. In dogs, sarcoptic mange occurs on the face but can spread to other parts of the body. Sarcoptic mange is transmissible to other dogs. If one dog is infested, all dogs that it has come in contact with should be treated for mite control. The animal should be dipped with an approved product. In the case of a puppy or stressed animal, a lime-sulfur prep should be used. Repeat the treatments for 4 to 6 weeks according to the intervals listed in the label directions. Treatment may require assistance from a veterinarian. Clip the infested dog's hair if it is a long-haired type. Dispose of all bedding and thoroughly vacuum. Dispose of the vacuum bag when finished cleaning.

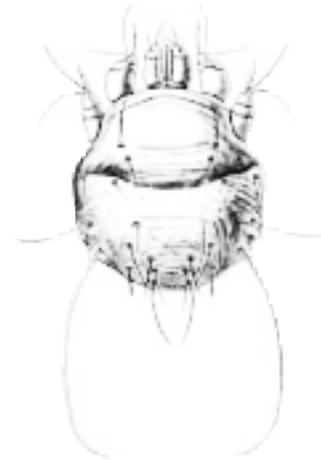


Figure 9.3 Sarcoptic mange mite general features.

Detecting and identifying sarcoptic mange mites can be difficult because the mites live in the skin burrows. Deep skin scrapings that cause blood to ooze from the scraping are required to scoop mites out of the burrows. The scrapings are then examined with a microscope. These mites are too small to be seen with the naked eye. Figure 9.3 shows a sarcoptic mange mite to illustrate general features. Precise detection and identification of these mites usually must be done in consultation with a

veterinary dermatologist, parasitologist or entomologist. Veterinary manuals contain information on identification and detection.

**Notoedric mange mites** are similar to the sarcoptic mange mites in biology, pathology, detection and identification, except that they are smaller. They occur in cats and rabbits and occasionally in dogs. One major species of notoedric mange mite parasitizes these animals, *Notoedres cati*. These mites cause feline scabies and head mange of cats. The mites burrow into the skin and exhibit a life cycle very similar to that of the sarcoptic mites. These mites primarily infest skin on the back of the neck, ears, face and paws, but may cover the whole body, especially in young animals. Detection and identification are done the same way with notoedric mites as with the sarcoptic mange mites.

Treatment for notoedric mange mites will require shampooing the animal with an insecticidal product for approximately four weeks at intervals described on the label. These mites die within a few days if they leave the host. This mange condition can be found in a few areas in the United States but overall it is a relatively rare disease.

The third group of burrowing mange mites affects domesticated fowl, including chickens, turkeys, pheasants, and caged pet birds. This group includes the scaly leg and depilating mites.

The scaly-leg mite, *Knemidokoptes mutans*, forms burrows under the epidermal scales on the toes, feet and legs of birds. The mites' burrowing and feeding activity causes inflammation, disfiguring of the skin with crusts, scale and scab formation and swollen legs and feet. The skin hardens and exudes fluid. Sometimes these mites also infest the comb and neck. Heavily infested birds may die because of hypersensitive allergic reactions. A very similar species, called *Knemidokoptes pilae*, causes scaly leg in parakeets. Another very similar species, *Knemidokoptes jamaicensis*, infests canaries.

With all of these mites, life cycles and detection methods are similar to those of the other burrowing mange mites.

## Non-burrowing Mange Mites

The non-burrowing mange mites do not form burrows in the skin. However, they do infest animal skin and cause mange. There are two important species of non-burrowing mange mites, but they are not typically pests of companion animals and so will not be discussed here and we will move on to other types of mite pests.

## Ear Mites

Ear mites are closely related to the non-burrowing mange mites, but they live on the skin of ear canals instead of on the outer skin. Two species of ear mites are important. *Otodectes cynotis* causes ear mange and lives in the ears of carnivores including dogs, cats and ferrets. *Psoroptes cuniculi* lives primarily in the ear canals of rabbits but also in horses, cattle, sheep and goats. It also causes ear mange.

The swarming, reproduction and feeding activity of these mites causes inflammation and intense itching in the ears of affected animals. Crusts form on the skin. An infested animal will often shake its head, carry the head to the side, scratch the ears and turn in circles as a sign of dis-equilibrium or dizziness. The ears may exude pus. Sometimes, in cases with extreme infestation and secondary infection, the eardrum will rupture, allowing the middle and inner ear to become infected with bacteria.

Detection and identification of ear mites is accomplished by ear scrapings or sampling with an oil-soaked cotton swab and microscopic examination. Infested animals with sensitive ear canals may not tolerate the use of an otoscope (ear examination instrument) and may need to be restrained. Obtain veterinary assistance. With other animals, examination of the ear with an otoscope will reveal mites crawling about in the ear canal. In this case, no ear swabbings are necessary.

## Hair Follicle Mites

Follicle mites are tiny, elongate mites that live in the hair follicles or **sebaceous (oil)** glands associated with hair follicles in mammals. The species of major importance to domesticated animals belong in the genus *Demodex* (See Table 9.1).

Follicle mites are common parasites of cats, dogs, horses and other large animals. In healthy animals, follicle mites do not cause any skin deterioration or mange. Animals with severe demodectic mange generally have immune systems that do not function properly. In weak or diseased animals, two skin conditions can develop. In the scaly skin condition, skin thickens and wrinkles and hair falls out. The skin turns color changing from its normal color to red or bruised-looking. In the pustular skin condition, pimples or pustules filled with pus develop. The pustules can develop into severe abscesses or nodules filled with fluid and pus. This skin condition usually develops after the scaly condition and reflects the development of secondary bacterial infections in the follicles. In both conditions, itching occurs. These skin conditions are collectively called **demodectic mange**.

Heavily infested dogs exhibit demodectic mange on several parts of the body, but particularly on the face and paws. Transmission of a mite population from bitch to nursing offspring by direct contact may occur during the first 2-3 days of life. Demodectic mange in dogs is also called **red mange**. Secondary bacterial infection, especially by *Staphylococcus*, as part of the overall mange condition can lead to death in dogs. Social stress may contribute to the onset of mange conditions.

Certain breeds of dog are more susceptible to generalized demodicosis (demodectic mange) condition. Breeds with predispositions include Old English sheepdog, collie, afghan, German shepard, akita, Staffordshire and pit bull terrier, Boston terrier, dachshund, chihuahua, boxer, pug, Chinese Shar-pei, beagle and pointers. All dogs with generalized demodicosis should be neutered after being successfully treated. This will reduce the continuation of hereditary predisposition.

In other animals, follicle mite infestation is usually asymptomatic (showing no symptoms). Cats and horses can exhibit mild demodectic mange. Feline demodicosis is rare, usually localized and a self-limiting condition. Burmese and Siamese breeds may be more susceptible to generalized (covering much of the body) feline demodicosis. Hamsters and laboratory rodents may also develop mange caused by hair follicle mites. Treatment is often difficult and should be accomplished with assistance from a veterinarian. Carbaryl shampoos and lime sulfur preps used according to label directions may be used to control mange mite problems.

Detection and identification of follicle mites can be done by trained persons by scraping skin deeply (as with burrowing mange mites), or by expressing pustules or abscesses and preparing slides for microscopic examination. There are no other mites that have the elongated appearance of follicle mites, shown below (Figure 9.4).

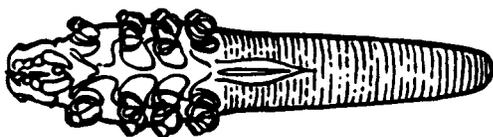


Figure 9.4 Hair follicle mite.

## Other Mites: Fur Mites, Chicken and Fowl Mites, Chiggers, Oribatids and House Dust Mites

Several other kinds of mites bite or infest domesticated animals. Larvae of **chigger mites** normally parasitize wild rodents. Two species

affect small animals. The North American chigger is bright orange-red in both the larval and adult stage. Chiggers may cause itchy lesions on animals that crust over. They may be found on legs, feet and ears. The larvae attach to the skin and suck tissue fluids. Larval chiggers seek hosts by clinging to vegetation near ground level and waiting for an animal to pass by. Chiggers typically occur in low-lying, humid environments such as stream sides and marsh or lake edges.

Diagnosis of chiggers on animals includes the observance of bright orange mites, crusty lesions, skin scrapings, and environmental history of being in woods and fields. Treatment includes dips and shampoos with an insecticidal product according to label directions. Keep animal out of contaminated areas to prevent reinfestation.

Three closely related mites called **fur mites** (all in the genus *Cheyletiella*) infest the skin of rabbits, dogs and cats. Younger animals, primarily kittens and puppies, are affected. These *Cheyletiella* mites cause itching, dermatitis (walking dandruff), weeping skin, mange and severe scaling, primarily along the dorsal midline, but may become generalized (covering much of the body) (see Table 9.1).

The mites suck lymph (body fluid). They spend their entire life cycle on the host but, unlike the burrowing and non-burrowing mange mites, they do not burrow into the skin or cause scab formation. Detection and identification can be accomplished by microscopic examination of skin scrapings and consultation with identification guides or qualified personnel. This mite is relatively easy to kill. Use lime-sulfur preps according to label directions, once weekly for 3 to 4 weeks. Dispose of bedding and thoroughly vacuum. It is usually a self-limiting problem in affected humans.

*Dermanyssus gallinae*, the **chicken roost mite** (or just **chicken mite**), infests domesticated fowl as well as wild birds such as pigeons and house sparrows. During the daytime, these mites hide in cracks and crevices in the birds' roosts and in poultry houses. At night, the mites leave their refuge, infest the birds and feed on their blood.

Sometimes chicken mites leave the nests of pigeons or sparrows and invade houses, biting people. This occurs especially when the adult birds leave their nests after the young have fledged (acquired feathers necessary for flight). This is not uncommon when the birds roost in the eaves of houses. Identification should be attempted with help from an entomologist or parasitologist.

## Endoparasitic Mites

Some mites occur in the internal organs and tissues of animals, particularly the respiratory passages. These mites are appropriately classified as endoparasites. For example, *Pneumonyssoides caninum* infests the sinuses and nasal passages of dogs. They should not be dealt with strictly as arthropod pests suitable for control with miticides by a certified applicator, but rather should be referred to veterinarians for any necessary treatment.

Mites in the family Oribatidae (commonly called **oribatid mites**) are generally free-living and occur in soil. Though these mites are not typically ectoparasitic on domestic animals, some of them are important as intermediate hosts for certain tapeworms (genus *Moniezia*) that infect cattle, sheep and goats. The mites ingest tapeworm eggs found in animal feces. Inside the mite, immature stages of the tapeworm (called cysticercoids) develop. Cattle may later ingest the mites as they graze in pasture and become infected with the tapeworms.

The final group of mites of veterinary importance are the **house dust mites**. These mites are not ectoparasites of companion animals (dogs or cats). The mites live indoors, in bedding and furniture and anywhere dust accumulates. They feed on dandruff and other organic materials in the dust. The cuticle, excrement and molted exoskeletons of the mites can cause allergies in companion animals and humans. Allergies to house dust mites are common and can be a significant dermatological problem for dogs. Use of miticides for control of these mites is not recommended. Instead, environmental sanitation for control is the best approach.

**Veterinarians perform skin scraping and ear swabbing for mite detection where mange, fur or ear mites are suspected**

Mites causing mange or infesting the fur or ears may initially be suspected if an animal's behavior or appearance changes from normal to abnormal. Gross changes in coat or skin condition or excessive licking and scratching can be signs that mites have infested the animal at unhealthy levels.

Detection (or diagnosis) of mite infestations of animal skin and ears can be accomplished by examining the entire body surface using a hand lens. However, mange, ear and fur mites may be more readily and definitively detected by the skin scraping technique. Skin scrapings must be performed by a veterinarian.

As discussed in several sections above, skin scraping may be shallow (i.e., not draw blood) or deep (i.e., slightly draw blood) and will reveal

non-burrowing, burrowing and hair follicle mites, depending on the depth of the scrape. Veterinarians trained in skin examination and diagnosis of dermatological and ear problems in animals should be consulted for assistance with these detection methods. These experts can help to determine if the perceived problem is caused by mite infestation or something else.

## CONTROL OF MITES ON ANIMALS OR IN ANIMAL ENVIRONMENTS

It should be obvious from the information above that there are many kinds of mites that affect the health of many kinds of domestic animals. Thus, the measures to control mite problems will vary with the species of mite and the host animal involved.

The first step in management of mite ectoparasites is to provide for good health, because it helps maintain the animal's resistance to mite infestations. Housing, nutrition and sanitary conditions should be at optimal levels. Animals held under crowded conditions, on poor diets and in unclean housing will be more likely to contract or harbor infestations of mites. Animals in poor health for other reasons are more susceptible to mite infestations and may be reservoirs of mites, causing infestations of healthy animals. Newly acquired animals should be examined for pests and, if necessary, treated to prevent contamination of animals already present.

Control of mites on animals or in the environment usually requires use of approved pesticides or drugs. The choice of which pesticide to use, or which drug, will vary with the mite and the animal infested. Pesticides that are used to control mites or ticks are called **acaricides**. It should be noted that not all insecticides approved for lice (more than one louse) control are approved or effective for mange mite control.

**Companion animals and small animals.** Companion animals (i.e., dogs and cats) and other small animals such as pet rabbits can become infested with mange mites or follicle mites. Dogs can be affected by the scabies mite, *Sarcoptes scabiei* var. *canis*, while cats and rabbits are affected by the burrowing mange mite, *Notoedres cati*, and the fur mite, *Cheyletiella*. The best treatment for mange mites in these animals is dipping in an approved acaricide. Dusts may be used for light or localized mange mite infestations. These treatments will also effectively kill fur mites.

Follicle mites are present in many dogs and usually cause limited problems. However, some

dogs develop severe infestations of follicle mites that require treatment. The infestations can be localized (in one area of the skin) or generalized (covering much of the body). Treatment consists of cleaning the affected areas with disinfectant scrubs and then applying approved acaricides under the direction of a veterinarian.

**Ear mites in small animals.** Ear mites in cats and other small animals (e.g., dogs and rabbits) can be detected by the methods described above. After detection, ears should be thoroughly cleaned to remove any waxy buildup. Then, applications of approved drugs or acaricides are given under the direction of a veterinarian.

## TICKS

There are more than 800 species of ticks belonging to two families: the **soft ticks** (family Argasidae, 160 species) and the **hard ticks** (family Ixodidae, 650 species). Ticks are close relatives of the mites; many scientists feel that ticks evolved from mites into parasitic associations with animals during the time of the large reptiles (about 200 million years ago).

Ticks are **obligatory** blood feeders on vertebrate hosts. This means that they depend entirely on blood for food and survival. They parasitize reptiles, birds and mammals. No ticks feed on plant juices or prey on other arthropods.

Ticks are of major worldwide veterinary importance for the following reasons:

- They cause blood loss.
- Their feeding causes inflammation and irritation of the skin.
- They may stimulate hypersensitive allergic reactions.
- They may cause a toxic reaction in the host, complicated by paralysis (called “tick paralysis”).
- They transmit microorganisms that cause disease.

Arthropods that transmit pathogenic microorganisms are called “vectors” of the diseases that the pathogens cause. For example, *Ixodes scapularis*, commonly called the black-legged, is a vector of Lyme disease.

### Hard Ticks

Ticks are small arthropods, but all life stages can be seen with the naked eye. Figure 9.5 shows an example of a hard tick. The feeding apparatus of a tick, like that of a mite, is called the hypostome. The hypostome allows the tick to suck

blood. The legs are segmented. The rest of the body of the tick is the abdomen. On the back of the abdomen of hard ticks is the scutum or shield. The scutum is often colored and has holes and lines in it (called “ornamentation”). The ornamentation of the scutum is important in identifying hard ticks. Some hard tick species have ridges or festoons. In female hard ticks, the scutum does not cover the body completely. In male hard ticks, the scutum covers the body. Ticks do not have antennae.



Figure 9.5 The American dog tick, an example of a hard tick

### Soft Ticks

Soft ticks look very different from hard ticks. The hypostome of soft ticks does not project forward— it is tucked underneath the abdomen and is not visible from above. Soft ticks do not have a scutum, nor do they have elaborate coloration patterns. Instead, the body is covered with bumps and folds.

### Tick Development and Feeding

Biological development of ticks starts with the egg stage and is followed by three more stages: six-legged larva, eight-legged nymph and eight-legged adult. Hard ticks have only one nymphal instar (that is, one molt to the nymph stage, followed by a molt to the adult stage). Soft ticks may have up to seven nymphal molts, depending on the species of tick and the kind of life cycle involved.

Each stage of a tick must feed on blood. Blood is the sole nutrient source for ticks and allows them to develop and molt to the next stage. For adult female ticks, blood provides the nutrients to develop eggs.

Blood feeding by ticks is a complex behavior and a physiological interaction with the host being fed upon. Ticks usually locate hosts

through “questing.” During questing behavior, a tick climbs to a perch (such as a blade of grass or end of a branch) and extends its legs. When an animal passes by the perch and brushes against it, the tick grabs onto the animal’s fur. The tick then crawls about the body of the animal until it finds a suitable place to attach its mouthparts. The tick inserts its hypostome into the skin and secretes a cement from the salivary glands to hold the hypostome in place. The tick then starts to take blood. For hard ticks blood feeding lasts several days to weeks of attachment. Most species of soft ticks blood-feed for only minutes to hours at a time. Many soft ticks do not quest as described above, but rather walk to a host to feed.

## Tick Life Cycles

Ticks have complex life cycles involving several blood meals with the same or different animal hosts and may include long periods of time when they are not on a host but living in the environment. Indeed, one of the characteristic features of ticks is that even though they are highly dependent on blood for food, they may survive away from a blood host for long periods. Some species of ticks can live for years away from a host.

Soft ticks are usually associated with nests, dens, burrows or roosts of their animal hosts. Soft ticks usually mate when they are not on a host. Hard ticks are generally not associated so closely with their hosts but instead are free-ranging and come into contact with animal hosts only for blood feeding. Hard ticks usually mate when they are on a host, oftentimes while the female is blood feeding. Because soft ticks take small blood meals for a short feeding period, the female lays only a few hundred eggs during her lifetime, with eggs laid at intervals. Hard ticks take large blood meals and lay 6,000 or more eggs at one time.

Ticks have four generalized life cycles. These life cycles are related to the number of individual animal hosts a tick will visit and feed on during its life from egg to adult. The life cycles are called **one-host life cycle**, **two-host life cycle**, **three-host life cycle** and **multihost life cycle**. Ticks are often referred to by the kind of life cycle they have for example, the American dog tick is a three-host tick.

The three-host life cycle has been adopted by about 625 species of the hard tick family. Therefore, this is the most common tick life cycle. The larvae find a host and feed for days. They drop off the host after feeding and wait days to weeks for the blood meal to digest. They then molt to the nymph stage. The nymph finds a new host (of

the same or a different species of animal that the larva was feeding upon), blood-feeds, drops off and digests the blood. It then molts to the adult stage. These ticks quest for a new, third host. They feed and mate on this third host. The females drop off after feeding, digest the blood and lay eggs. Males stay on the host, often do not feed and die after mating.

In the three-host life cycle, the larvae and nymphs typically feed on smaller animals (for example, birds or rodents) than do the adult ticks (for example, deer or cattle). Three-host tick cycles may take years to complete, depending on the environmental and climatic conditions in the area.

The two-host life cycle occurs in 12 of the hard tick species. This life cycle is very similar to the three-host life cycle. Two-host ticks generally do not occur in North America, though in other parts of the world they are extremely important pests of animals.

The one-host tick life cycle occurs in about 12 species of the hard tick family. Larvae, nymphs and adults all feed upon the same animal host without dropping off of it to molt. One-host ticks are important pests of domesticated animals in North America and elsewhere.

The multihost life cycle is characteristic of nearly all of the species of soft ticks. Multihost life cycles take place in areas where host animals dwell, such as dens, burrows, nests and other shelters. In this life cycle, many nymphal molts occur and these nymphs are called intermediate stages. Larvae find a host in the shelter and feed. They detach from the host, stay in the shelter, digest the blood and molt to the first-stage nymph. The nymphs repeat the feeding and other activities of the larvae. Individual nymphs feed and molt several times before molting to the adult stage. Adults quest for and feed on a host in the same shelter as the nymphs and larvae. The adult ticks feed and may feed many times. The female ticks lay small batches of eggs after each blood feeding.

## DETECTION AND IDENTIFICATION OF TICKS

Ticks can be detected on animals by direct examination without use of a hand lens or microscope. Engorged ticks (those filled with blood) are particularly easy to see because they are large and obvious, looking somewhat like a castor bean in shape and color. To find ticks on an animal, ruffle or comb fur or feathers to expose the skin and

examine skin directly. Ticks may have preferred attachment sites that protect them to a certain degree from being dislodged by animal grooming. Areas around the head, in the ears, on the shoulders and other parts of the body can harbor attached ticks. Unattached ticks can be recovered from host fur by combing and examining the comb.

Tick identification can be accomplished with the use of references and biological identification keys. Identification is important because certain tick species transmit agents that cause serious diseases; other ticks do not. Thus, correct tick identification can help animal health care professionals make decisions about the need for diagnostic tests for tick-borne diseases.

A pictorial key to the genera of adult ticks in the United States is given at the end of this chapter. Identification of ticks to particular species often requires consultation with experts, who can be contacted through local county Extension offices or health departments. Immature ticks, larvae and nymphs, are difficult to identify even with the aid of a microscope. An expert should be consulted to determine if a particular arthropod is an immature tick and, if so, what species.

## IMPORTANT TICKS AFFECTING ANIMAL HEALTH

Many species of ticks affect animal health. Ticks may be encountered on companion animals, other animals in agricultural settings and even animals in pet shops or zoos. Additionally, ticks are

important ectoparasites of wild animals and may seriously affect the vigor of individuals and the fitness of whole populations.

Table 9.2 lists several important tick species found in the United States, their distribution and common names, which domesticated animals the ticks commonly parasitize and the diseases they are associated with as vectors. Of these, the important ticks of the north central part of the United States are discussed in detail below.

The **American dog tick**, *Dermacentor variabilis* (Fig. 9.5), is widespread in the eastern United States. The American dog tick is brown with white ornamentation on the scutum (shield on the abdomen) in the adult stage. It parasitizes wild woodland rodents in the larval and nymphal stages. As an adult it will commonly occur on dogs and wild canines, raccoons, opossums, cattle, horses and humans.

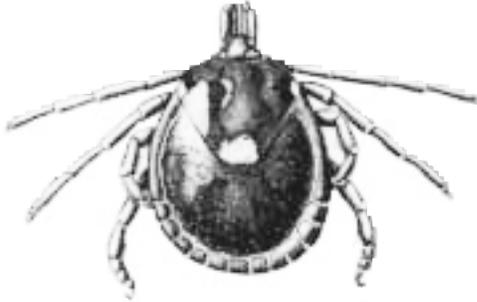
The American dog tick is a three-host tick. It is an important vector of the rickettsial microorganism that causes Rocky Mountain spotted fever. This disease is also known as American tick-borne typhus. Dogs and humans can contract Rocky Mountain spotted fever, a serious and potentially fatal disease characterized by unusual spotted rashes and high fever. The American dog tick can also transmit the rickettsial microorganism that causes canine ehrlichiosis. This is a disease of dogs once thought confined to Asia but now documented in areas of the United States.

The **lone star tick**, *Amblyomma americanum* (Figure 9.6), is a common and problematic tick of the south central and southeastern United States, but these ticks appear every year in north central

**Table 9.2 Common ticks affecting animal health in the northcentral region of the United States**

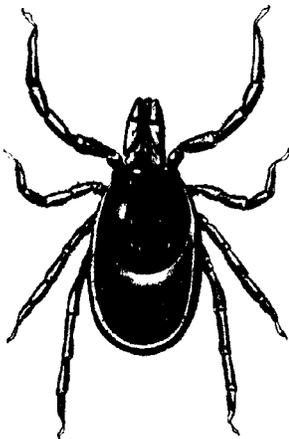
Tick Animals Parasitized	Tick Common Name	Scientific Name	Geographical Distribution	Disease Associations
Dogs, cats, cattle, horses	American dog tick	<i>Dermacentor variabilis</i>	Eastern U.S., California	Rocky Mountain Spotted Fever
Wide range of birds, mammals	Lone star tick	<i>Amblyomma americanum</i>	Southern states east of Texas	Rocky Mountain Spotted Fever
Rodents, dogs, cattle, horses, deer, cats	Black-legged tick	<i>Ixodes scapularis</i>	Upper midwest, eastern coast states	Lyme disease
Dogs, mainly	Brown dog tick	<i>Rhipicephalus sanguineus</i>	Worldwide, indoors	

states (probably brought up by northwardly migrating birds). The tick gets its name from the bright, lone star-like spot on the scutum of the female. The male and immature ticks lack this spot. Lone star ticks are vectors of Rocky Mountain spotted fever rickettsiae. The lone star tick is a three-host tick. It parasitizes a wide range of birds (particularly the larvae and nymphs) and mammals, including dogs, cattle, horses, sheep and humans.



**Figure 9.6** The lone star tick is a common and problematic tick of the south central and southeastern United States. These ticks appear every year in north central states (probably brought up by northwardly migrating birds).

The black-legged tick, *Ixodes scapularis* (Figure 9.7), is a three-host tick with a prolonged two-year life cycle. In the larval and nymphal stages, it quests for woodland rodents such as mice and chipmunks, but it will also parasitize ground-foraging birds. Adult ticks are found on larger sized wild mammals but will also parasitize humans, dogs, cats, horses and cattle.

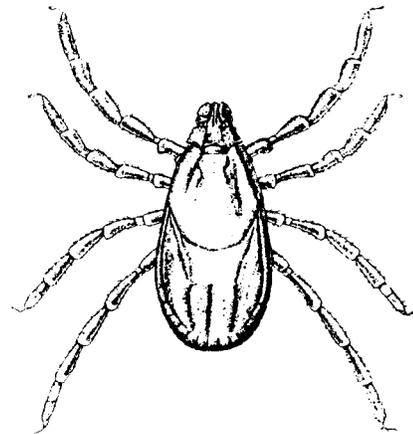


**Figure 9.7** Black-legged tick.

*Ixodes scapularis* is the vector in the eastern United States of *Borrelia burgdorferi*, the bacterium that causes Lyme disease. Lyme disease is a chronic, debilitating disease that may initially manifests itself as a rash in humans and may later lead to chronic arthritis and possibly heart and nervous system problems. Dogs, horses and

possibly cattle show some symptoms of Lyme disease, indicating that they indeed can become infected following a tick bite.

The brown dog tick, *Rhipicephalus sanguineus* (Figure 9.8), is a three-host tick that generally occurs in indoor, doghouse, or kennel situations. The brown dog tick does not occur outside. Though it mainly is an ectoparasite of dogs, it also will parasitize wild animals, zoo animals and, rarely, humans. In northern temperate climates, this tick is exclusively an indoor tick. In some parts of the world, brown dog ticks are vectors of some pathogens of dogs, including Rocky Mountain spotted fever. These ticks also are vectors of the causative agent of canine babesiosis (or malignant jaundice), a malaria-like infection.



**Figure 9.8** Brown dog tick.

## MANAGEMENT OF TICKS ON ANIMALS

Management of ticks affecting companion animals varies with the species of tick and the kind of animal that needs protection. When only a single tick, or a few ticks are on an animal, simply remove them using tweezers or fingers. If you use your fingers, be sure to wear protective gloves or a use barrier such as a tissue. Be sure not to squeeze the tick—you could cause any disease organism in the tick to go into the animal. Grasp the tick as close to the skin as possible and pull firmly away until it detaches. Ticks should not be removed by burning or using materials such as kerosene or diesel fuel. Heavily infested animals should be dipped, dusted or shampooed with an acaricide and then combed thoroughly to remove the ticks. Be careful with cats—they are very sensitive to pesticide toxicity.

Tick attachment to dogs and cats can sometimes be prevented with the use of acaricide- or insecticide-impregnated collars. These collars may not be entirely effective, especially when the animals

are large and have a heavy coat. Some animals react negatively to these collars. Observe their behavior closely and remove the collar if they become lethargic or nauseous, or if they act abnormal or sick in any way.

The brown dog tick can be an important indoor or kennel pest of dogs. For this tick, treatment of the indoor environment should be coupled with

on-animal tick control. Brown dog ticks live away from the animal in cracks and other hiding places. Approved acaricides should be directed into these areas with dusters or sprayers. Foggers and aerosols can also be used to deliver acaricides to indoor environments. They must also be directed into the tick's hiding places.

---

## Chapter 9 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. What two features generally distinguish mites and ticks from insects?
2. What four ways do mites affect the health of animals?
3. What is one of the most common problems that mites cause in animals? Please describe it.
4. Describe the generalized life cycle of mites.
5. How long does the entire life cycle of a mite take?
6. Why do sarcoptic mange mites cause intense itching and dermatitis on the animals they infest?
7. Animals affected with sarcoptic mange may scratch so heavily that liquid exudes from the affected skin, causing skin crusts and skin cracking and thickening. True or False?

8. Secondary infection is common in scratched areas. True or False?
9. Notoedric mange mites are similar to the sarcoptic mange mites in biology, pathology, detection and identification, except that they are smaller. What host animals do they infest?
10. How can you detect and identify non-burrowing mange mites?
11. Follicle mites are common parasites of cats, dogs, horses and other large animals. True or False?
12. In healthy animals, follicle mites normally do not cause any skin deterioration or mange conditions. True or False?
13. In weak or diseased animals, follicle mites can cause two skin conditions to develop. Please describe them.
14. What are the skin conditions caused by follicle mites called?
15. Both endo- and ectoparasitic types of mites occur. True or False?
16. Allergies to house dust mites are not common and are not a significant dermatological problem for dogs. True or False?
17. Describe why ticks are of major worldwide veterinary importance.
18. Each developmental stage of a tick must feed on blood because blood is the sole nutrient source for ticks and allows them to develop and molt to the next stage. True or False?
19. Ticks can be detected on animals by direct examination without use of a hand lens or microscope. True or False?
20. If an animal has ticks, what are the control options?

# CHAPTER 10

## CHEWING AND SUCKING LICE

### LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Tell what sucking and chewing lice feed on.
- Describe the general appearance of lice.
- Explain the general life cycle of lice.
- Understand how to control lice and prevent the spread of lice.

Lice (singular: louse) are insects belonging to either the **sucking louse** order (**Anoplura**) or the **chewing or biting louse** order (**Mallophaga**). All lice are obligatory ectoparasites of birds and mammals. There are about 460 species of sucking lice and 3,000 species of chewing lice. Sucking lice feed solely on blood and have mouthparts designed for sucking. Their mouthparts penetrate the skin and actually fit into a blood vessel, from which the blood meal is drawn. Sucking lice occur only on mammals.

Biting lice have mouthparts designed for chewing, not sucking, and they feed on feathers, hair and skin scales. They live on mammals and birds. An infestation of lice is called **pediculosis**.

Lice are highly host-specific—that is, a particular species of louse is generally associated with only one kind of animal host. Often, a species of louse will even be restricted to one part of the body of one kind of animal host. Lice do not survive long if they are removed from their host, so they live on the host all the time. They are transferred from host to host by direct contact.

Infestations of lice are associated with overcrowding and poor sanitation in the animal's environment. Infestations are seen mostly in the winter. Long winter hair coats are desirable homes for lice. Populations are limited by summer heat.

Lice are wingless insects that are flattened from top to bottom. They are usually tiny to minute in size (from 1 to 5 mm in length), though they can be seen with the naked eye. Figure 10.1 shows a typical chewing louse and a typical sucking louse.

The head of a sucking louse is much narrower than that of a chewing louse. As a general rule, the **head of a sucking louse is narrower than the thorax** (middle body part), whereas the **head of a chewing louse is wider than the thorax**. The legs often have claws to grasp hairs or feathers.

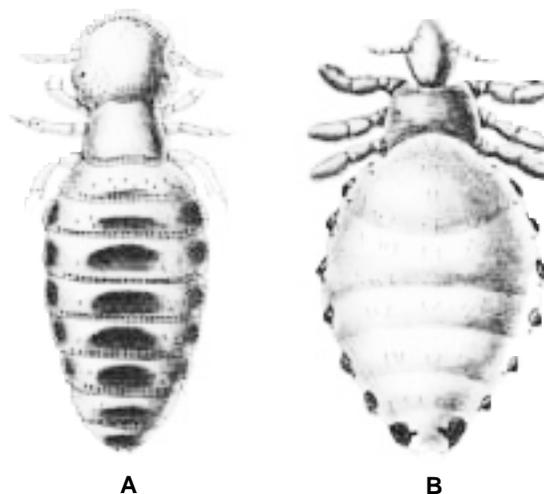


Figure 10.1 Typical chewing louse (A) and a typical sucking louse (B).

### LICE LIFE CYCLE

The eggs of lice are called nits and are cemented to hairs or feathers on an animal host. The eggs hatch and larval lice, called **nymphs**, emerge. Nymphs blood-feed. Nymphs continue to feed and molt three times before maturing into adult male or female lice. The adult lice mate and the

females lay eggs onto host hairs or feathers. The entire life cycle takes up to 30 days or more, depending on temperature. All life stages of lice occur on the host.

## EFFECTS OF LICE ON ANIMAL HEALTH

A single animal may be infested with thousands of lice. Their feeding activity results in hair or feather loss, blood loss, skin irritation and secondary infection. Lousy animals may be weak and susceptible to other infestations or diseases. Infested animals will scratch frequently, worsening the condition. However, grooming by the host animal may remove lice and help lessen the effects of lice activity. Also, an animal's immune system may affect lice and reduce their numbers. Some animals may be infested with lice and show no ill effects. For example, one study showed that 50 percent of the individuals in a herd of beef cattle were infested with lice but only 2 percent were severely infested and showed pathological signs.

## Lice of Companion Animals and Horses

Dogs and cats may occasionally be infested with chewing lice. The dog biting louse (Figure 10.2) is uncommon but may harm dogs, particularly puppies, when present in large numbers. The cat biting louse occasionally occurs on cats.

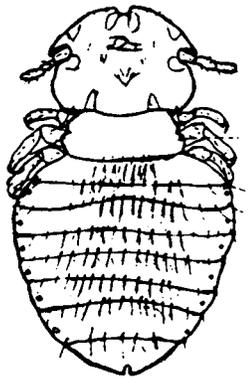


Figure 10.2 Dog biting louse.

## LICE MANAGEMENT

Prevention involves isolation or culling of chronic lice carriers so that lice will not be transferred to non-infested animals. Animals should be checked and treated for lice before being added to a kennel, cage or exercise area with other animals. Remove thick mats of hair before treating, and treat all contact animals.

Lice control on animals involves use of insecticides. Many young animals acquire lice from infested mothers during the suckling stage. Some insecticides cannot be used on young animals, or on pregnant or lactating mothers. Therefore, the least risky lice management strategy is to control the lice on both adults prior to mating. If the mother does not have lice, the offspring will not contract an infestation from contact with their mother. Read all label directions and precautions before applying products to animals.

Check treated animals for lice at two-week intervals after application and retreat if lice are found. Retreatment is often necessary because many insecticides do not kill the eggs or nits. Lice may hatch from eggs that survive an insecticide treatment and reinfest the animal. The louse life cycle must be completely broken on each animal.

Apply insecticides as coarse sprays, pour-ons, dips, shampoos or dusts of registered insecticides. All accompanying animals, litter mates or those in the same cage, kennel, exercise area or home should also be treated. The animal's living quarters and bedding must be treated and disinfected.

---

## Chapter 10 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. What do sucking lice eat? How do they obtain it?
2. Lice can survive for extended periods of time between hosts. True or False?
3. Describe the physical difference between sucking and chewing lice.
4. List two ways lice infestations can be influenced or reduced on animals.
5. Why is it important to control lice on both adult animals prior to mating?
6. To prevent reinfestations from surviving eggs, the \_\_\_\_\_ of the lice must be completely broken on each host animal.

---

# CHAPTER 11

# FLIES

## LEARNING OBJECTIVES

After you complete your study of this chapter, you should be able to:

- Understand the general life cycle of flies.
- List the three groups of biting and nuisance flies.
- Explain how various flies are pests of animals.
- Describe the three components of a biting-fly management program.
- Explain why house fly populations can quickly build to enormous levels.
- Understand the need for an integrated management program for filth flies and animal waste management.
- Describe the options available for managing flies on and around animals.

---

Flies are insects with only one pair of wings. They belong to the insect order Diptera (meaning “two wings”). Though most kinds of flies are harmless to animals, several families of flies are major pests of animals and often require management. Some flies are vectors of disease agents of animals.

The fly pests of animals fall into three groups:

- **Blood-feeding flies** not associated with manure or animal waste.
- **Filth flies** associated with animal waste or manure.
- **Parasitic bot flies.** Bot flies are not considered as common pests of small animals so we will not discuss them in this manual.

All flies have a true metamorphosis life cycle (the immature stages or larvae appear worm-like and may sometimes be true maggots). Some filth flies, especially the stable fly, are also blood feeders.

## BITING FLIES

**Blood-feeding flies: Mosquitoes, black flies, biting midges, deer flies and horse flies** are blood-feeding flies. Only the female flies take blood. They use it for egg yolk development inside the abdomen. The females have piercing mouthparts that are either blade-like and cut the skin or needle-like and pierce the skin. The mouthparts taken together are called the

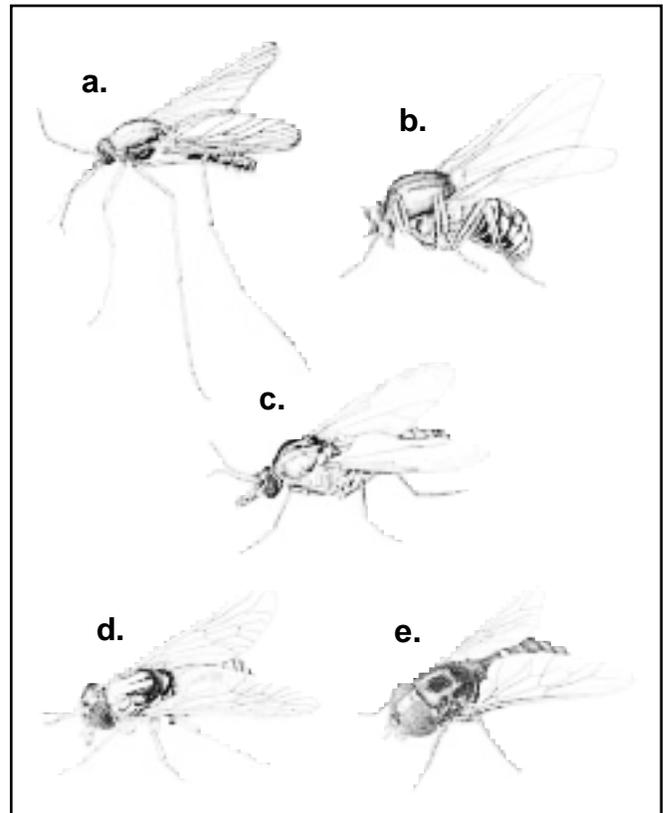


Figure 11.1 Blood-feeding flies: a. Mosquito b. Black fly c. Biting midge d. Deer fly e. Horse fly.

proboscis. Male flies in these groups feed on nectar or other sugar sources. Table 11.1 lists the groups of blood-feeding flies. Various blood-feeding flies are shown in Figure 11.1.

**Table 11.1 Blood-feeding flies affecting domesticated animals in the United States.**

Common Name	Scientific Family
Mosquito	Culicidae
Black fly	Simuliidae
Biting midge	Ceratopogonidae
Deer fly	Tabanidae
Horse fly	Tabanidae

**Mosquitos'** developmental cycle includes an aquatic larval stage. Mosquito eggs are laid singly or in clusters on or near water. Larvae hatch from the eggs and develop in the water. The larvae feed on a variety of microorganisms and organic matter in the water and develop through four larval stages or instars to the pupal stage. Adult mosquitoes emerge from the pupae and fly away. Female mosquitoes seek out animal hosts, using cues such as carbon dioxide and moisture in exhaled breath to find them. Most mosquitoes seek hosts in the evening or at night, though some will bite in the daytime. Once they have found an animal host, mosquitoes will forage over its body until they find a bare patch of skin. Then the mosquito probes the skin with its needle-like mouthparts, finds a blood vessel and sucks blood. Usually only a few minutes are required for blood feeding. Some large animals may experience hundreds to thousands of mosquito bites per night if left unprotected. After blood feeding, the engorged female mosquito leaves the animal and rests in the environment while the eggs develop. She then lays eggs and seeks a host for blood again. A single mosquito may bite several times in its lifetime.



Many mosquitoes will bite domestic animals, causing injury by blood loss and creating wounds where bacteria may invade and cause infection. Some animals may develop allergies to mosquito bites. In addition, mosquitoes transmit disease agents to animals. Dog heartworm is caused by a

nematode. Infected dogs have adult worms in their hearts. The adult worms shed tiny, immature worms called microfilariae into the bloodstream. When mosquitoes bite an infected dog, the microfilariae enter the body of the mosquito with the blood. Days to weeks later, when the mosquito locates another dog, it transmits the worms during blood feeding. A single infected dog in an area can be an infective source for uninfected dogs for miles around. Thus, it is important to protect dogs from heartworm through preventive drugs and to keep them safe from mosquito bites. If left untreated, heartworms in dogs are deadly.

**Black flies** may be severe seasonal parasites of large animals in Michigan. The larvae occur in slow- or fast-moving streams and rivers, where they cling to rocks and filter out food particles from the passing water. The larvae pupate on the rocks, then the adult black flies emerge, swim to the water surface and fly away. Female black flies swarm around and onto the bodies of animals. The bites are very irritating, and large numbers of bites can cause severe reactions such as toxemia or anaphylactic shock (allergic reaction). In some instances, high numbers of black flies caused blood loss so extreme that cattle died of anemia. Black flies can transmit a malaria-like disease to waterfowl.

**Biting midges**—also called “punkies,” “no-see-ums” or “sand flies”—are tiny biting flies with speckled wings. The larvae occur in still or moving water, where they live in the mud, sand or debris at the bottom. Though these flies are very small, their bite is very irritating. Bites may swell and form bloody, weeping lesions similar to black fly bites.

**Deer flies and horse flies** are large-bodied flies and strong fliers. They live as long as 6 weeks. The larvae are found in a variety of aquatic and semi-aquatic conditions and in moist soil, where they live in the mud and sediments and prey on worms and insects. Most horse and deer flies have only one generation per year. The adults emerge in early to midsummer. Adult females obtain a blood meal and later lay eggs on vegetation above still water or moist soil. After hatching, larvae drop into the water, develop and crawl to drier areas to become pupae. This insect overwinters as a mature larva.

Deer and horse fly bites are painful and injurious. The flies bite by a scissors-like action of their bladed mouthparts that causes a pool of blood to form, which they then suck up. The flies bite during daytime hours. Animals can injure themselves by attempting to drive off or escape from

these flies. Deer and horse flies are important vectors of the virus that causes **equine infectious anemia** or **swamp fever** of horses.

## MANAGEMENT OF BLOOD-FEEDING FLIES

Management of biting flies to prevent bites is an important part of animal health care, for both companion animals and livestock. There are three components to biting fly management. First is modification of the habitat and environment. For mosquitoes, this means eliminating local sources of standing water around the animals. Most mosquitoes come from true wetlands, however, so draining larval breeding sites is usually not possible nor desirable and must be done with the approval and collaboration of natural resources authorities. Control of larval mosquitoes with insecticides is feasible but this is a specialized discipline requiring training and expertise. The best approach to mosquito control is a regional (e.g., township or county) system utilizing multiple strategies for control of larval and adult mosquitoes. Extension bulletin E-2180, "Mosquito Pest Management," is a training manual for mosquito control and pesticide applicators' certification.

Little can be done about the immature stages of black flies, biting midges, deer and horse flies. Black fly larvae can be controlled in streams with insecticidal bacteria, but this strategy requires permits and consultation with experts.

The second component to biting fly management is to separate the animals from the flies through physical means. Animals can be kept indoors when the flies are biting.

The third component to biting fly management is the use of repellents on the bodies of animals and insecticides applied to the animals directly or in their immediate environment. For mosquito control, residual premise sprays of insecticides are effective applied to areas where mosquitoes rest, including barns or animal dwellings, sheds and vegetation. Ultra-low volume application of insecticides is an effective way to control mosquitoes and other small biting flies both inside and outside premises. Thermal fogs can also be used inside and outside dwellings for mosquito control.

In general, insecticide use for control of biting midges, black flies, deer and horse flies is limited to topical applications on animals directly. Black flies often attack the ears of animals, so applications of mineral oil or mild insecticides to the ears can provide relief to an animal. Follow all label directions.

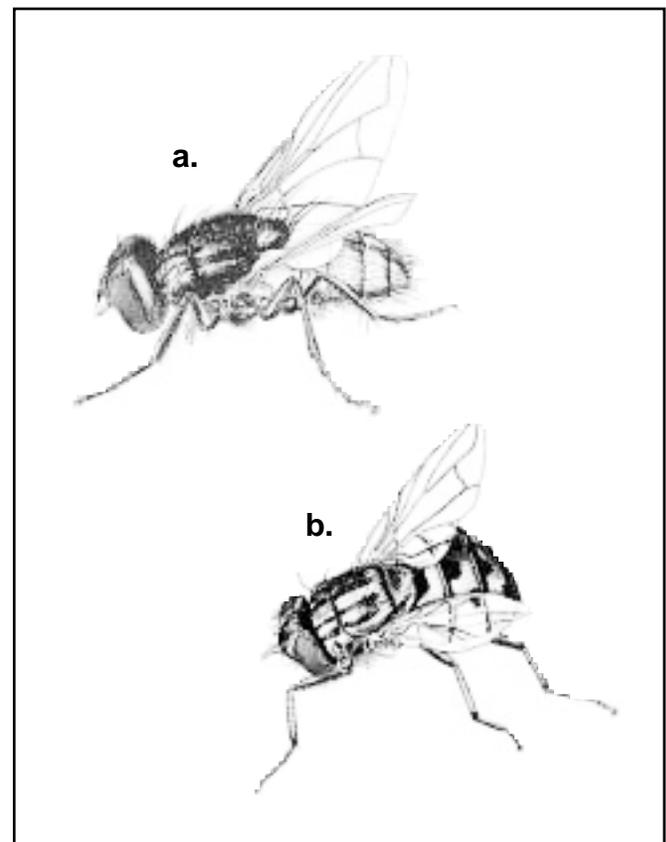
## NUISANCE FLIES

**Filth flies associated with animal waste.** Filth flies often constitute a problem for animal facilities. Filth flies affect animals by their annoying or blood-feeding activity. Some filth flies are vectors of disease agents to animals and humans.

Additionally, the close proximity between animal care facilities and human settlements has created situations where filth flies become a source of annoyance and concern for neighbors. On the other hand, maggots of filth flies play an important ecological role—they degrade manure to simpler constituents and reduce the volume of waste material. As pests and disease vectors, filth flies often must be managed. Table 11.2 lists the filth flies and Figure 11.2 shows certain adult filth flies.

**Table 11.2 Filth flies affecting domesticated animals in the United States.**

Common Name	Scientific Name
House fly	<i>Musca domestica</i>
Stable fly	<i>Stomoxys calcitrans</i>
Face fly	<i>Musca autumnalis</i>



**Figure 11.2 Adult filth flies: a. House fly b. Stable fly.**

Fly bite dermatitis (Fly bite ears) is caused by the rasping teeth and mouthparts of stable flies. Stable flies inflict a very painful bite, irritating to the host. These flies lay their eggs in moist manure or compost. The adult flies prefer strong light and are more abundant in summer and autumn. These flies affect the faces and ears of dogs. Lesions are seen on tips of ears or at the folded edge of flop-eared breeds. The lesions may have dark crusts and be oozing blood and serum.

Animals should be protected from stable fly attacks with the use of repellents such as sprays or pastes. Keep the animal indoors or in a shelter when fly populations are high. Proper handling and disposal of manure and compost are essential and may require insecticide treatments.

Filth flies, like other true flies of the insect order Diptera, have four life stages: egg, larva (or maggot), pupa and adult. Perhaps the most important filth fly with widespread distribution in Michigan is the **house fly**. Larvae of this fly develop in a wide range of materials, including fresh manure, animal waste mixtures of manure and straw, hay or feed and garbage. The adult flies are gray/black with yellowish sides and are 6 to 7 millimeters long. They have sponging mouthparts and lap up materials from animal wastes and liquefying organic matter. Under typical summer conditions, house flies can achieve 10 to 12 generations per year (with 8 to 22 days required for a full development cycle from egg to adult), so these flies increase in number as the summer progresses. The adult flies commonly migrate 1 to 3 miles, and movement up to 13 miles within 24 hours has been documented. House flies can serve as intermediate hosts for a roundworm parasite of horses.

House fly populations can build to enormous numbers in animal containment settings. They have several generations per year. The annoyance factor for companion animals is difficult to assess, but the buzzing sound of the flies and their aggregation at sores and mucous membranes to feed may cause undesirable behavioral changes. Annoyance of humans by house flies is well known.

## MANAGEMENT OF FILTH FLIES

Management of filth flies must be integrated with animal waste management practices. The overall aim is to remove manure. If it cannot be removed, manure must be dried out so maggots cannot develop. Good kennel sanitation, such as regular removal of manure from confinement settings, is critical in a successful pest management program.

### Basic Daily Kennel Maintenance Program

1. Observe each animal for signs of distress or illness.
2. Remove any animal exhibiting distress or illness to an isolation area. Report condition to manager and obtain assistance from veterinarian.
3. Complete feces chart.
4. Remove bedding material, examine feces and urine for any abnormalities, and place in plastic trash bag. Replace bedding materials. If trays are used, sanitize and replace.
5. Check food container to determine consumption rate and possible contamination. Record on health record any eating abnormalities.
6. Remove food containers, sanitize and refill as appropriate.
7. Check water containers to determine water supply and cleanliness. Note on health records if it appears that water is not being consumed.
8. Remove open water containers, wash, disinfect, rinse and refill. Examine sipper-type water bottles to determine if cleaning and/or refilling is required.
9. Clean each cage, wash thoroughly with cleaning solution of warm water and detergent, and make sure all fecal material is removed. Then wipe down with hypochlorite (bleach) and water solution. Mix solution: 1 part hypochlorite to 28 parts water. Recommend using 32-ounce bottle with one-ounce markings on side.  
**CAUTION:** Do NOT mix ammonia and hypochlorite. This mixture creates intense heat and toxic fumes that are dangerous to humans and animals.
10. Wash kennel floor, walls and windows.
11. Soak kennel grids and doors in sink if needed.
12. Towel dry kennels.
13. Replace bedding materials, food and water supply.
14. Check collars or other identification devices for each animal before replacing in cage.
15. WEEKLY: Inspect and wipe clean ventilation intake and exhaust vents in kennel area. Test kennel doors for security and check all cage surfaces for smoothness and overall condition.

Insecticides can be used effectively for adult fly control as space sprays, residual sprays or direct application to animals as dusts, gels or wipes.

**Space or area sprays** applied as mist, fog or ultra-low volume applications, typically control flies only at the time of application and within a limited area. A mist blower, fogger, ultra-low volume sprayer or hydraulic sprayer type equipment is required. Area sprays are usually mixed with water to dilute them from high concentrations (25-50 percent) to low concentrations (0.15-1.0 percent) before application. The insecticide label gives instructions on proper dilutions.

**Residual sprays** for filth flies are typically emulsifiable concentrates or wettable powders (both mixed with water, as indicated on the label, before use). They are applied as a wet spray to surfaces or vegetation where flies rest. In contrast with area sprays, which offer no residual activity, this approach offers some residual activity.

**Larvicides** have had limited success in killing maggots in manure or animal waste, so this control measure is not generally recommended. In cases where the use of larvicides is the only option, then application of labeled rates as a coarse spray is appropriate.

**Insecticide-laden baits** can be used for house fly management. Baits can be purchased ready to use or prepared as bait stations with residual insecticides mixed with sugar and put in burlap or paper bags. Baits are useful in indoor settings. When baits are used, they should be placed where animals or children cannot come into contact with them. Besides baits, certain traps can be used for fly control. Jars baited with fish heads or other smelly materials typically attract green blow flies and do not control house flies or stable

flies. Sticky traps made of stiff paper or a fiberglass panel coated with either insecticide or a sticky glue will attract some flies and offer localized control.

Certain insecticides can be **directly applied onto animals** according to label directions to protect them from flies. The insecticide applications are dips, wet sprays or dusts applied directly onto the animal. In each case, the specific application depends on the target insect pest and the species and condition of the animal. Many restrictions apply to insecticide applications on young animals and lactating mothers. Read and follow all label precautions and directions carefully.

If an animal is infested with fly maggots or wounds and areas of moist dermatitis, consult a veterinarian for treatment. Maggots may be associated with fecal deposits that accumulate around the animal's anal area.

Indoor areas that animals frequent or where they are stalled must be kept clean of accumulating waste. House fly and stable fly development requires wet or moist conditions, so control of standing water and good drainage are very important. Maintain a clutter-free environment in and around kennels, exercise areas, grooming areas and the entire facility. This will enhance safety and make cleaning easier.

Certain biological control agents, such as predators, parasites and pathogens of the immature stages of filth flies can be integrated with other control methods. These agents work best in warmer southern states or indoors where they can overwinter. In northern states, these agents are mainly experimental. Obviously, any use of biological control agents such as parasites of the fly pupae will be useful when combined with other physical, cultural and insecticidal methods.

---

## Chapter 11 – Review Questions

**Write the answers to the following questions and then check your answers with those in the back of this manual.**

1. How many pairs of wings do flies have?
2. What are the three groups of fly pests of animals?
3. What do the immature stages or larvae of flies look like?
4. Name three of the blood-feeding flies.
  - 1.
  - 2.
  - 3.
5. Which of the blood-feeding flies has a developmental cycle involving water or aquatic habitats?
6. Dog heartworm is caused by a nematode and is transmitted between dogs by mosquitoes. True or False?
7. What are the three components to biting fly management?
8. What important ecological role do filth flies fulfill?
9. Some filth flies are vectors of disease agents to animals and humans. True or False?
10. What is the difference between a space or area spray and a residual spray?

---

# APPENDIX A

## CAGED ANIMALS

**The following information will not be part of the State of Michigan pesticide applicator certification examination.**

The Michigan Department of Agriculture Animal Industry Division is responsible for licensing and regulating animal shelters, dog pounds, pet shops, riding stables and research facilities. The humane treatment of animals is one of the division's priorities. The MDA Animal Industry Division inspects animal facilities to assure they are clean and not overcrowded and that wholesome food is provided to the animals. If problems are found, inspectors work with company personnel to bring the conditions up to high standards for the welfare of the animals. Provided below are some guidelines for establishing these standards for caged animals. Persons in this industry should obtain a copy of the **Animal Welfare Act of 1976** and learn the standards for the care of animals outlined in it. For more information contact the MDA Animal Industry Division at (517) 373-8782.

Information on ferrets is not included because it is illegal to have ferrets as pets in Michigan, according to Act 277 of 1927, Ferrets and Fitchews.

With permission, the information in this appendix has been adapted from the Pet Industry Joint Advisory Council (PIJAC) training materials.

### Receiving Animals

If you work in a pet store-type business, the following guidelines provide an overview of the minimum standards that you should adhere to and be familiar with when acquiring and caring for small animals.

The method of animal shipping and receiving varies with species and means of transportation. Those sent by commercial airlines usually arrive in wood or cardboard containers that provide

temporary housing. The animals should be removed from shipping containers immediately after arrival at your establishment and provided fresh water.

Visual inspection of the container should verify that the number of animals agrees with the number stated on the bill of lading. If an animal is discovered to be dead on arrival or the count does not agree with the number stated on the bill of lading, note this information on the bill of lading before signing for the shipment. The carrier and your supplier should be notified of the incident and copies of the necessary airline report forms should be filed.

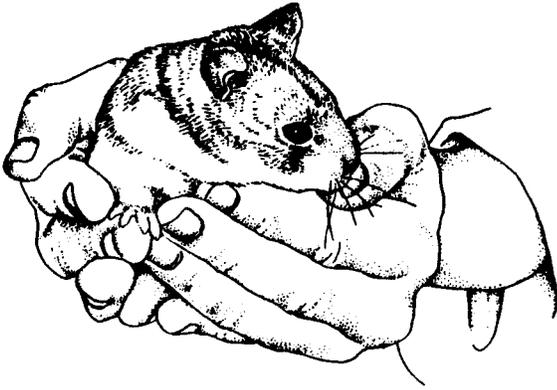
### Handling Animals

Persons who handle animals should be trained on correct handling and restraining techniques to avoid injury to the handler and the animal. Animals are often fearful when in unfamiliar surroundings and should be handled with extreme caution. Correct use of holds may benefit both the animal and the handler. Inspecting an animal may be accomplished effectively with two persons, one acting as handler and the other as examiner.

Not all animals will require firm restraining. The amount of restraint needed will depend on the environment and the animal's behavior. Animal behavior will vary greatly, and handlers must learn to "read" the animals' body language. Speak to the animal initially in a soothing voice to prevent startling it. Obtain animal handling training to protect yourself and the animal. The following information may be used as general guidelines for picking-up and holding some small animals commonly found in pet stores. Always seek assistance if you are uncertain about a particular animal, how it may react and how it should be handled.

## How to Pick Up a Hamster

The hamster should be fully awake before you attempt to pick it up. Grasp the hamster with both hands, as shown in the illustration, to lift it out of the cage. To prevent the hamster from escaping, a small animal box or new container should be close by to facilitate the transfer.



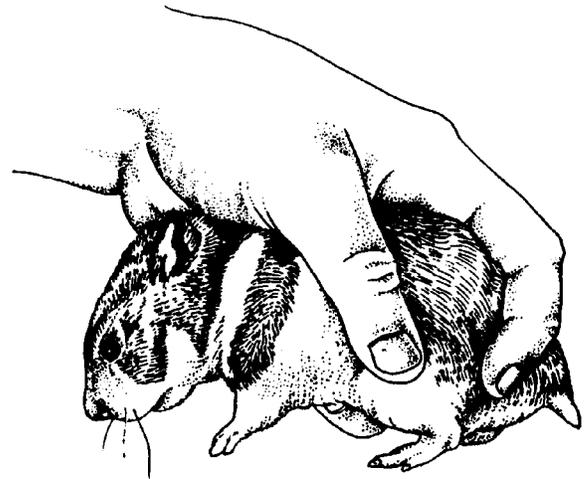
The hamster has very loose skin in the neck area. When picking up a hamster, use the method shown in the following illustration. A good deal of fur and skin should be grasped to prevent the hamster from wiggling loose or turning around and biting.



You can also use a receptacle to scoop up a hamster. This facilitates the transfer from the cage without the possibility of being bitten.

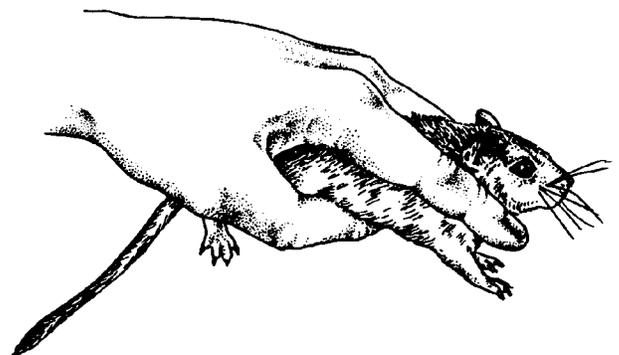


The one-hand method of grasping a hamster, as shown in the illustration below, should be used **only with very tame hamsters**. This type of grip prevents the hamster from falling.



## How to Handle a Gerbil

To grasp a gerbil, the over-the-back grip is recommended.

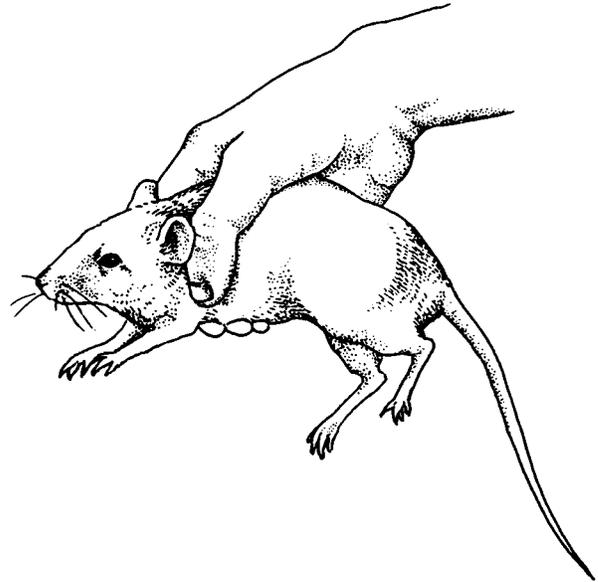


To pick up a gerbil, grip the base of the tail. NEVER attempt to pick up a gerbil by the end of the tail because the tuft and tail skin may pull off.



## How to Pick Up a Rat

Pick up the rat by grasping it over the back and rib cage. Using this method you can place the pet in a small container to examine it. (Note: rats will struggle if turned belly up.)



## How to Hold a Guinea Pig

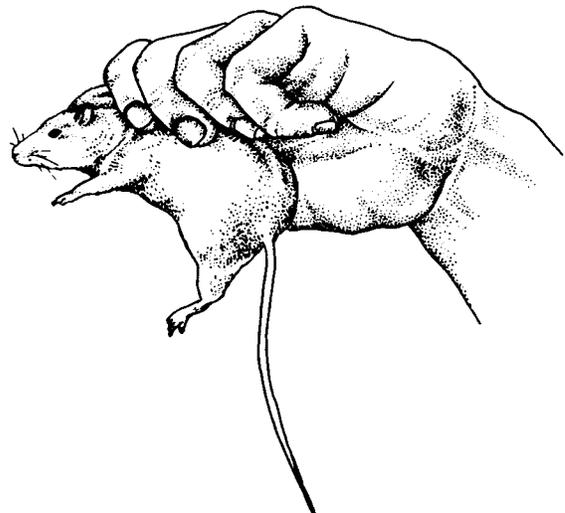
The chest area must be supported to prevent injury. The rump is supported to prevent back injury and to restrain the guinea pig from kicking.



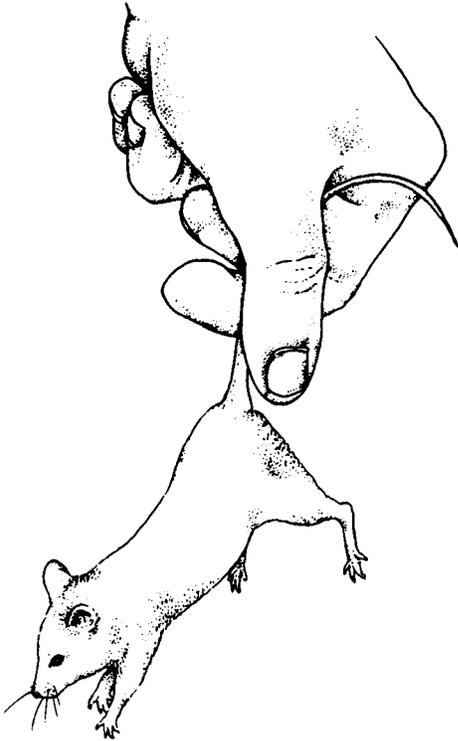
If the rat is in a wire mesh bottom cage, grasp as above and by the base of the tail, to aid in freeing the claws from their grip on the mesh.

## How to Pick Up a Mouse

Grasp loose skin along back to restrain a mouse.

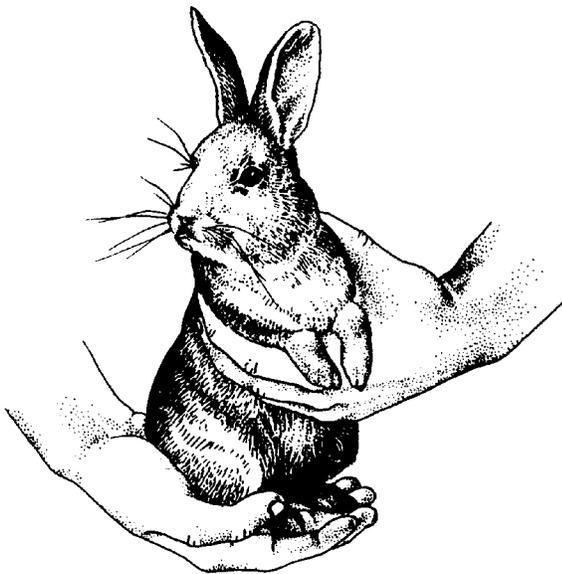


Mice, like gerbils, can be picked up at the base of the tail. **NEVER** pick up the animal at the tip of the tail because the skin may slough off.



## How to Pick Up a Rabbit

It is important that rabbits be picked up properly. **NEVER** pick up the animal by the ears—it can harm the rabbit and cause it to be frightened whenever it is approached. Place one hand beneath the rabbit's hind legs and the other around its chest. Make sure that the rabbit doesn't kick out of your grasp.



## Small Animal Housing

The environment that animals are maintained in significantly affects their well-being. Their housing should be adequate in size, clean and free from sharp edges. The following suggestions will help ensure animal comfort:

1. Use only cages fabricated of smooth, corrosion-resistant material impervious to moisture and easily sanitized. Select glass aquariums with tight fitting screen lids easy to maintain.
2. Metal cages should be constructed of galvanized metal, stainless steel, aluminum or similar metal alloys.
3. Metal cages may have bottoms of expanded metal or a galvanized wire mesh. Wire mesh floors should be smooth and free of sharp protrusions, and the grid should be small enough to prevent feet from falling through openings.
4. Small animals should be separated according to sex when possible to aid employees in making sales presentations.
5. Fresh water should be available at all times.
6. Cage lids, food and water containers, and cages should be cleaned and sanitized periodically, as needed.
7. Bedding material should be absorbent and of a type that can be eaten by the animals. It should not contain fine particles that might be inhaled.
8. Soiled bedding should be removed from the cages. Loose hair should also be removed to reduce likelihood of clogging vents.
9. Keep cages dry to avoid fly breeding, especially in corners, with resultant growth of maggots.
10. Where possible, use an ultraviolet light equipped with a Woods filter to detect evidence of ringworm. This is a common problem in guinea pigs.

## Colonizing

When selecting housing and placing animals in cages, consider the following behaviors and precautions:

**Hamsters** – Do not overcrowd or mix strangers in with an established colony. Try not to mix sexes because of the potential for fighting or breeding. Keep cool to prevent wet tail.

**Gerbils** – Do not overcrowd or mix strangers in with an established colony. Strange adult males will fight.

**Guinea pigs** – Do not overcrowd. Long-haired guinea pigs should be housed separately from short-haired ones because the short-haired ones will eat the long hair.

**Rats** – Do not overcrowd.

**Rabbits** – Do not overcrowd or overheat.

**Mice** – Do not overcrowd.

## Special Housing Considerations

**Hamsters** – Special housing requirements for hamsters include a temperature of approximately 68 degrees F and low (50 percent) humidity. High heat and/or humidity can contribute to a serious condition called wet tail. Twelve hamsters in a 10 gallon tank can raise the ambient temperature 6 to 8 degrees. Therefore, room temperature should ideally be kept at 62 degrees F. Because this is impractical (and hazardous to most other animals), it is recommended that hamsters be placed in wire cages rather than tanks. This allows good air circulation.

Hamsters should not be housed in fish or grooming rooms because of the high humidity. If a tank must be used, observe the following guidelines:

1. Don't overcrowd—12 animals per 10-gallon tank is maximum.
2. Use a screen cover and locate the tank in a well ventilated area.
3. Clean tank (or cage) regularly to prevent urine buildup. Add ground corncob to wood shavings (1:3 ratio) for super absorption of urine and humidity.

**Gerbils** may be housed in an aquarium or tank equipped with screen covers, sipper-type water bottles and ground corncob bedding. Aquarium size should be determined by the number of animals in inventory. Corncob bedding is important—its granular shape simulates the natural sand substrate. When animals burrow, the bedding removes excess hormone buildup from around the muzzle area, thus preventing the hair loss syndrome common in gerbils.

**Rats, mice and guinea pigs.** An aquarium with screen cover, sipper-type water bottles, and cedar or pine shavings constitutes an adequate housing unit. Aquarium size should be determined by the number of animals in inventory.

**Rabbits** may be housed on a wire grid in a pen-type structure. A medium mesh base is recommended for rabbits because of their high urine output. Consider a combination floor for animal comfort.

## General Small Animal Maintenance Program

### DAILY:

1. Visually inspect animals for signs of distress or illness. Report illness to manager and/or consult a veterinarian.
2. Medicate as approved by cooperating veterinarian.
3. Determine whether odor problem exists. Correct immediately, if necessary.
4. Separate sick or injured animals.
5. Remove open water containers, wash, disinfect, rinse and refill. Examine sipper-type water bottles and clean, if needed.
6. Remove food containers, wash, disinfect, rinse, dry and refill.
7. Wipe clean aquarium glass inside and out.
8. Wipe off and check screen covers for secure fit.
9. Remove fecal material and other debris.
10. Vacuum or mop floor.

### 3 to 5-day Intervals:

1. Change bedding.
2. Clean each cage, wash thoroughly with cleaning solution of warm water and detergent. Make sure all fecal material is removed. Wipe down with hypochlorite (bleach) and water solution. Mix solution: 1 part hypochlorite to 28 parts water. Recommend using 32-ounce bottle with 1-ounce markings on side.

**CAUTION:** Do not mix ammonia and hypochlorite. Mixing ammonia disinfectants with any hypochlorite solution causes intense heat and highly toxic fumes dangerous to humans and animals.

3. Wash, disinfect and rinse all sipper-type water bottles or drinking devices.
4. Replace all cracked aquariums, damaged cages, and/or damaged screen covers.
5. Check drug, food, cleaning supplies inventory. Prepare list of needed supplies for manager.

## Potential Caged Animal Disorders

The environmental conditions of an animal greatly influence its health and well-being. Good sanitation, a fresh water supply and adequate space will help ensure animal comfort. From time to time, problems may arise. Observe animals daily and note any abnormal conditions or behaviors. Consult with a veterinarian when you discover animal health problems.

---

## APPENDIX B

# BIRDS

**The following information will not be part of the State of Michigan pesticide applicator certification examination.** This information is provided for persons who care for and work with birds.

The Michigan Department of Agriculture Animal Industry Division is responsible for licensing and regulating pet shops, animal shelters, dog pounds, riding stables and research facilities. The humane treatment of animals is one of the division's priorities. The MDA Animal Industry Division inspects animal and bird facilities to assure they are clean and not overcrowded, and that proper, wholesome food is provided to the animals and birds. If problems are found, inspectors work with company personnel to bring the conditions up to high standards for the welfare of the animals. Provided below are some guidelines for establishing these standards for caged animals. Persons in this industry should obtain a copy of the **Animal Welfare Act of 1976** and learn the standards for the care of animals outlined in it. For more information, contact the MDA Animal Industry Division at (517) 373-8782.

With permission, the information in this appendix has been adapted from the Pet Industry Joint Advisory Council (PIJAC) training materials.

### Receiving Birds

Birds should be purchased only from reputable breeders or brokers or from USDA-approved quarantine stations. Any individual offering birds at a bargain price may be attempting to sell stolen or smuggled birds. Such birds may be incubating a fatal disease that could destroy your aviary and your reputation. Periodically review published price lists and advertisements in avicultural magazines to get an idea of current prices.

**Check both Federal and state laws to determine which species of birds are prohibited and which require permits to be brought into the state to sell or possess.** Check each bird against the original order to ascertain that the correct species and number are received.

**The Pet Industry Joint Advisory Council (PIJAC)** strongly endorses the use of an avian vet-

erinary specialist to examine and supervise the medication and treatment of birds.

**Even though federal regulations do not require that bird shipments be picked up within four hours after arrival, PIJAC urges that the four hour rule be followed for birds.** Upon receipt, check the birds against the information on the shipping documents.

Before receiving new birds, check to be sure that all necessary supplies are available and the receiving cages have been cleaned and sanitized and are ready with food and water.

Check with your suppliers to determine the birds' diet. Be prepared to continue feeding the birds' previous diet to avoid sudden dietary changes which may result in unnecessary stress. Gradually change the birds' food to the diet preferred in your facility. Do not give grit—stressed birds may overeat.

Birds should be unpacked quickly and then left alone with adequate light to allow them to find food and become acquainted with their new environment. If the birds arrive at night, dimmed lights should be left on.

### Bird Examination

All birds should receive a cursory examination as they are removed from the crate and placed in the cage. The following preliminary examination should take only minutes and will not add significant stress to the shipping procedure. Obtain assistance from an experienced professional or veterinarian.

Newly arrived birds will usually look healthy. They will assume a flight or fight posture except when they are so debilitated they would be unable to fly. When placed in the new cage, they should remain alert and tightly feathered until the transfer is completed and the receiver has left the area.

Observe birds daily. The first observance should be from a distance of greater than 10 feet to prevent the birds from feeling intimidated and assuming the flight or fight position. Observe each bird and take notes on all birds that act list-

less or appear to have fluffed feathers. As you enter the area where the birds are housed, the birds should become alert and watch you. **Birds exhibiting abnormal behavior should be isolated and individually examined with the assistance of a veterinarian.** Examine the birds':

- Weight.
- Eyes.
- Nose.
- Feathers.
- Beak and mouth.
- Feet, legs and wings.

NOTE: Failure to eat is common following shipment, but any bird that does not eat after 24 hours is in danger of starvation and may require force-feeding. Check with the supplier for suggestions on diet or management.

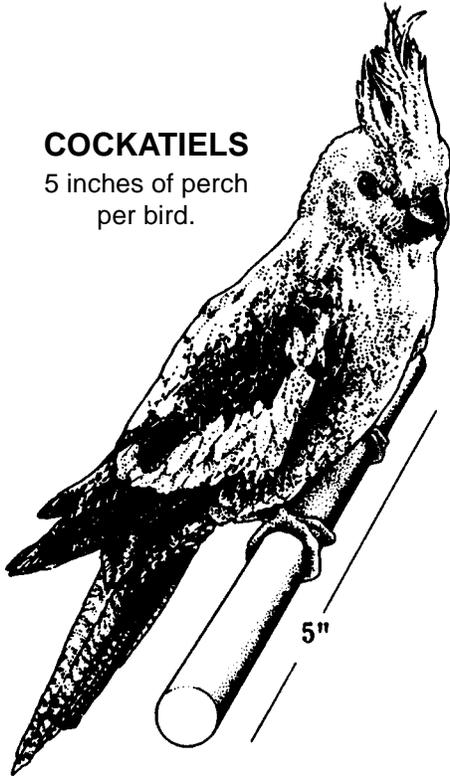
## Housing

1. Caging should be constructed of materials that are impervious to moisture, easy to disinfect and strong enough to withstand chewing of occupants. The paint on cages from foreign countries should be checked as a potential source of lead.
2. Birds—except for long-tailed species—use horizontal cage space more efficiently than vertical space. Horizontal cages have more floor space, reduce fecal contamination of food and water supplies, as well as soiling of other birds, and provide better space for exercise.
3. Height provides security for birds. Housing birds at or above eye level reduces stress and limits access to the birds by curious children or mammals that may escape or be allowed to roam in the shop.
4. Cages must be strong enough to prevent birds from pulling them apart.
5. Cages for long-tailed birds should have adequate room for the bird to fully open the wings without touching the sides and top. Natural wood perches from non-toxic trees provide the best foot exercise as well as chewing material for psittacines (parrots). Finches and canaries should have two perches available to encourage them to fly between them.
6. Parrots and other large bird species should have sufficient cage space or sufficient T-stand perch space.
7. Perches in the isolation area should be of an impervious material such as PVC to allow for easy disinfection (wood surfaces are too porous).
8. Perches in the sales area may be wooden dowels of adequate size to afford the bird a secure, comfortable grip. Natural limbs, however, provide better foot exercise and chewing opportunities and are aesthetically pleasing. Branches are replaced easily and should be pesticide free and from non-toxic trees such as northern hardwoods, citrus, eucalyptus or Australian pine. Sandpaper perches should not be used.
9. A single well placed perch may be adequate for agile climbers. Passerine birds should be provided two perches to fly or hop between. In cages with more than one bird, all perches should be at the same height to avoid fighting over the highest perch. Perch space should be adequate so that all birds can sit comfortably on the perches simultaneously.
10. Discard wooden perches used by a sick bird.
11. If a perch is detrimental to the health of a particular species, perches should be omitted.
12. Feed cups and water containers should be located for easy accessibility by the bird.
13. Food and water containers should be hooded, if necessary, or placed away from perches to prevent fecal contamination.
14. Grit is not necessary for psittacine birds, though a few pieces provided once or twice yearly are not harmful.
15. During the molting of feathers, additional fat, protein and vitamins are recommended and the bird may require more time to sleep.
16. A healthy bird can tolerate temperatures that are normally comfortable to humans. Sudden temperature changes may be a potential threat to sick birds.
17. Cages or aviaries should be cleaned daily.
18. Daily paper change and weekly cage washing are recommended.
19. Many birds benefit from the availability of a hiding place such as a box or paper bag.
20. Toys are useful as mental diversions and tend to encourage exercise and beak wear. Chewable items are preferred and safety must be considered in toy selection. A few toys, which may be provided alternately, are preferable to many toys filling a cage.
21. A healthy, tamed, trained bird is easier to sell than a bird that is not socially adapted to human contact. Make sure to take time each day to play with and talk to the birds in your store. Birds must socialize before being handled. Birds that respond to customers will help sell themselves.

## Minimum Perch Length Guidelines

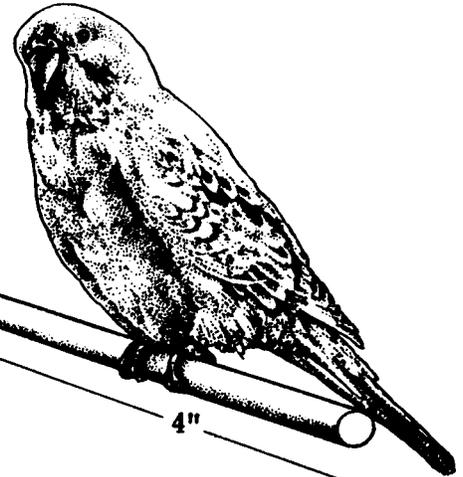
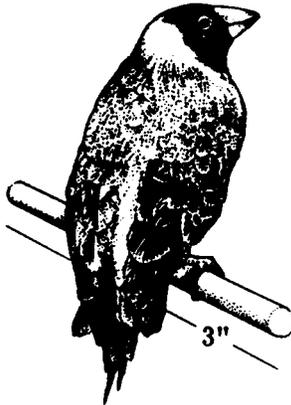
### COCKATIELS

5 inches of perch per bird.



### FINCHES

3 inches of perch per bird.



### PARAKEETS

4 inches of perch per bird.



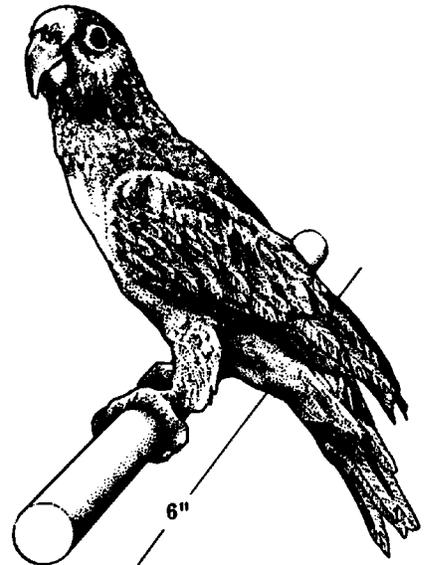
### PARROTS

9 inches of perch per bird.



### MACAWS & COCATOOS

10 inches of perch per bird.



### CONURES

6 inches of perch per bird.

## Feeding and Nutrition

Providing the most accurate, up-to-date information on bird care is a vital function of the pet shop. The sale of high quality nutritional items and bird care products, along with suitable housing for the bird, make it a better companion pet.

Over-the-counter remedies should be available for those customers who will not seek veterinary care. Shop personnel, however, should avoid playing veterinarian. The following recommendations should provide a basis for bird care in the shop as well as recommendations to customers.

Proper nutrition and a varied diet should be stressed. Many good commercial pelleted or extruded diets are on the market. These products may be fed exclusively but should be mixed with seeds and other foodstuffs.

Mixes should contain a variety of seeds and must be clean, fresh and free of insects. Feed should be stored in closed bins.

The diet should be supplemented with fresh fruits, vegetables (dark green and meaty yellow vegetables), beans and whole grain products. Consult a veterinarian for proper types and proportions of foods that should be fed to seed-eating or soft-billed birds.

## Illness Identification

The most important tool for early identification and treatment of illness is observation. Part of your daily review of the bird department must include time spent observing each bird. In addition to recognizing disease symptoms early enough for effective treatment, you may prevent the spread of a disease among other birds. Birds can regress rapidly when ill. Early diagnosis and a veterinarian's assistance and treatment are essential in helping the bird recover.

The following list and chart will help you identify illness and other disorders, treat the birds and prevent the spread of the problem. For additional information you should refer to your bird supplier, publications on aviculture and your veterinarian.

## Warning Signs of Bird Problems:

1. Birds should appear calm and be sitting on the perch or climbing around the cage. A bird that is sitting on the floor is usually either frightened or ill and should be examined. The bird should be able to bear weight on both feet and both feet should grip the perch.
2. Nails are overgrown.
3. Wings are not held in proper position and are not symmetrical.

4. Feathers are puffed and dull or bird is not fully feathered and has bare spots.
5. Eyes are dull, not bright and clear. Any scabs on the eyelids, cere or toes should be noted—they may indicate pox virus infection.
6. Eye or nasal discharge is visible.
7. Beak is overgrown or asymmetrical.
8. Respiration is labored or accompanied by tail bobbing or open mouth breathing. Listen for wheezing, coughing or sneezing.
9. Fecal material has accumulated on the feathers or feet.
10. Bird is lethargic.
11. Bird is off feed — look for scraps on cage floor.
12. Growths or enlargements are obvious.

Any suspicious bird condition should be examined by your veterinarian and reported to the supplier as soon as illness is suspected.

## Bird Maintenance Program

### DAILY:

### SEED-EATING BIRDS

1. Observe each bird for signs of distress or illness. Note appetite, abnormal droppings or other problems on health records. Report illness, abnormality or loss to manager or veterinarian.
2. Remove birds exhibiting distress or illness to isolation area. Advise manager and consult veterinarian.
3. Remove and empty all water and seed cups.
4. Wash, disinfect, rinse, dry and refill seed cups with fresh seed. Replace in cage.
5. Wash, disinfect, rinse and refill water cups with fresh water. Replace in cage.
6. Remove and change cage paper as needed.
7. Clean and reposition perches as needed.
8. Remove fecal matter, loose feathers and excessive debris from cage.
9. Wipe off all cages with damp cloth to remove dust and fecal material. Clean glass.
10. Clean window glass and door glass.
11. Remove all loose seed, feathers and debris from bird area, including display shelves, cage stands and floor.

**Table 1. Some Bird Pests and Parasites.**

<b>Pest/Illness</b>	<b>Species Affected</b>	<b>Signs</b>	<b>Diagnosis</b>	<b>Treatment</b>
<b>Scaly face</b> <b>Scaly leg</b> <b>Mite</b> <b>Tassel foot</b>	All birds— parakeets, canaries most common	White, scaly deposits on eye- lids, beak corners, legs, toes and vent	Skin scraping examined by microscope	Veterinarian
<b>Feather mites</b> (Red mites)	All birds	Restlessness, severe scratching, feather picking, skin irritation	Small, moving red dots on white cloth hung over cage at night (red mites are nocturnal). Use magnifying glass. Red mites live in crevices in cage and feed on birds at night.	Dismantle, clean and spray cage. Use approved insecticide spray on bird according to label direc- tions.
<b>Lice</b>	All birds	Same as feather mites; feathers appear “moth eaten”	Eggs or lice attached to feathers. Lice are elongated.	Apply approved insecticide according to label. Be sure to apply under wings.
<b>Roundworms</b> (Ascarid)	All birds	Poor feather condition, weight loss, loose droppings	Stool sample— long, thin, white worms	Veterinarian
<b>Threadworms</b> (Capillaria)	All birds; parakeets and macaws most likely	Loss of appetite, weight loss, loose droppings, regurgita- tion, poor plumage	Microscopic exam of stool specimen	Veterinarian

**SOFT-BILLED BIRDS** — Same maintenance procedure as above, plus:

1. Wash, disinfect, rinse, dry and refill food cup with fresh food. Replace cup in cage.
2. Check cages several times during day to remove fecal materials as needed.
3. Check food several times a day to prevent contamination or souring.

**WEEKLY:**

1. Scrape all perches, wash and disinfect cages and trays.
2. Inspect and wipe clean ventilation system in bird area.
3. Redistribute bird inventory so there are no empty cages.

4. Check drug, food and cleaning supplies inventories. Prepare list of needed supplies for manager.

**RECORDKEEPING:** (Use a bird log sheet)

A record of sale of each psittacine bird should be maintained. Include:

**PURCHASES** –By species, the common and scientific name, the number, date of receipt, the name, address and telephone number of supplier. Verify name and address from identification document (driver’s license) if supplier does not normally supply pet store.

**SALES** –By species, the common and scientific name, the number, date of sale, and name, address, and telephone number of customer.

---

# APPENDIX C

## RESOURCES

To advance in your field and to stay up to date on information and practices, it is beneficial to become involved with professional organizations affiliated with the small animal industry. It is also valuable to acquire resources to use as references for your work.

The following list was created from suggestions by the industry committee that provided guidance in the development of this category 7G training manual. Reference to these resources, associations, products or companies does not imply endorsement by MSU Extension or bias against those not mentioned.

### PROFESSIONAL ORGANIZATIONS

**Pet Industry Joint Advisory Council**, 1710 Rhode Island Avenue, N.W., Washington, D.C. 20036. Telephone (202) 452-1525.

**Michigan Professional Groomers Association**. To become involved with the association's activities and training, contact a current member. Use the telephone directory to find current members by noting their affiliation in their advertisements. They will be able to provide you information about membership.

### REFERENCE BOOKS

**The Book of The Cat**. Michael Wright and Sally Walters. Summit Books. 1980. New York, N.Y. 10020.

**Cat Owner's Veterinary Handbook**. Carlson and Griffin, Howell Publishers.

**The Complete Dog Book**. 18th Edition, American Kennel Club, Howell Publishers.

**The Cornell Book of Cats**. Cornell Feline Health Center, College of Veterinary Medicine, 618 VRT, Ithaca, NY 14853-6401.

**Dog Owner's Home Veterinary Handbook**. Delbert G. Carlson, D.V.M., and James M. Giffin, M.D. 1989. New York, N.Y. 10169. Howell Book House.

**Manual of Clinical Procedures In the Dog and Cat**. Steven E. Crow, D.V.M. and Sally O. Walshaw, M.A., V.M.D. 1987. J.B. Lippincott Company, PA.

**Merck Veterinary Manual**. 7th Edition, 1991. Merck.

**Natural Health for Dogs and Cats**. Richard H. Pitcairn, D.V.M., Ph.D., and Susan Hubble Pitcairn. 1982. Rodale Press. Emmaus, PA 18049.

**The New Natural Cat: A Complete Guide for Finicky Owners**. Anitra Frazier with Norma Eckroate. 1990. New York, N.Y. 10014. Penguin books USA, Inc.

**Pet Allergies: Remedies for an Epidemic**. Alfred J. Plechner, D.V.M., and Martin Zucker, 1986. Inglewood, CA 90309. Very Healthy Enterprises.

**Your Healthy Pet: A Practical Guide to Choosing and Raising Happier, Healthier Dogs and Cats**. Amy Marder. 1994. Rodale Press. The columnist for Prevention shares her years of experience as a veterinarian by offering insights into cat and dog care, including: understanding symptoms of illness, feeding and weight maintenance, travelling with a pet, caring for teeth and proper vaccinations.

### MAGAZINES, NEWSLETTERS, SUPPLIERS

**Advocate**, 9725 E. Hampden Ave., Denver, CO 80231. Official magazine of the American Humane Society.

**Borderline**, 4575 Galley Rd., Suite 400-A, Colorado Springs, CO 80915. Official magazine of the American Boarding Kennels Association.

**Cat Fancy**, P.O. Box 6050, Mission Viejo, CA 92690.

**Dog Fancy**, P.O. Box 6050, Mission Viejo, CA 92690. Twelve issues for \$17.97.

**Dog World**, P.O. Box 6500, Chicago, IL 60680. Newsstand sales or subscriptions available.

**DVM Newsmagazine**, 120 W. 2nd, Duluth, MN 55820. Veterinary magazine.

**Groom & Board**, 207 S. Wabash Ave., Chicago, IL 60604. Groomer and kennel operator magazine with annual buyer's guide. Free to pet care professionals.

**Groomer to Groomer**, 341 N. 19th St., Camp Hill, PA 17011. Business-building newsletter with seminar information and letters from groomers nationwide. Free to purchasers of Barkleigh products or \$15/year.

**Groomer's Voice**, P.O. Box 101, Clark, PA 16113. Newsletter for members of National Dog Groomers Association of America. This group also sponsors continuing education training.

**Off Lead**, P.O. Box Drawer A, 13 Clinton St., Clark Mills, NY 13321. Dog obedience training magazine.

**New England Serum Company**, Groomer/Kennel Products Division, P.O. Box 128, Topsfield, MA 01983. 1-800-637-3786.

**Pet Age**, 207 S. Wabash Ave., Chicago, IL 60604. Free to pet professionals.

**Pet Business**, 5400 N.W. 84th Ave., Miami, FL 33166.

**The Pet Dealer**, 567 Morris Ave., Elizabeth, NJ 07802. Contains groomer column and calender. Special subscription rate.

**Pets-Supplies-Marketing**, E. First St. Duluth, MN 55802. Contains groomer calender and Shirlee Kalstone's grooming column plus buyer's guide. Free to pet professionals.

**Pure Bred Dogs-AKC Gazette**, 51 Madison Ave., New York, NY 10010. \$18/year.

**Veterinary Forum**, 1610-A Fredrica Rd., St. Simons Islands, GA 31522. \$15/year.

## PESTICIDE USE AND SAFETY INFORMATION

**Pesticides: How They Work, Human Poisoning Treatments.** MSU Extension bulletin E-0789.

**Pesticide Emergency Information.** May 1994, MSU Extension bulletin AM-37 or AM-37SP (Spanish version).

**10 Tips for Laundering Pesticide Soiled Clothing.** MSU Extension bulletin E-2149.

## OTHER INFORMATION SOURCES:

**Michigan Department of Agriculture**  
Pesticide and Plant Pest Management Division  
P.O. Box 30017  
Lansing, MI 48909 East Lansing, MI 48823  
(517) 373-1087

**Michigan Department of Agriculture**  
Animal Industry Division  
1615 South Harrison Road  
(517) 373-8782

### Regional MDA Offices:

- REGION 1 Room 117  
State Office Bldg  
Escanaba, MI 49829  
(906) 786-5462 (616) 947-3171
- REGION 2 Bldg. 42, Apt 132  
701 S. Elmwood Ave  
Traverse City, MI 49684
- REGION 3 State Office Bldg.  
350 Ottawa, N.W.  
Grand Rapids, MI 49503  
(616) 456-6988 (517) 771-1778
- REGION 4 Saginaw State Office Bldg  
411-F East Genesee  
Saginaw, MI 48607
- REGION 5 4032 M-139, Bldg. 116  
St. Joseph, MI 49805-964  
(616) 428-2575 Lansing, MI 48933



REGION 6 611 W. Ottawa  
North Ottawa Bldg.  
(517) 373-1087

REGION 7 Lahser Center Bldg.  
26400 Lahser Road  
Southfield, MI 48034

**Michigan State University Extension** county- and campus-based personnel. County office locations and telephone numbers are listed in the white pages of your telephone book.

---

# Answer Key to Pest Management for Small Animals Review Questions

## Chapter 1 Pesticide Laws and Regulations

1. FIFRA
2. Certified pesticide applicators
3. False
4. True
5. d
6. a
7. Department of Transportation (DOT)
8. Michigan Department of Agriculture
9. b
10. True
11. False
12. Agreements between states to allow certified applicators in one state to use pesticides in another state.
13. b
14. True
15. c
16. Michigan Department of Natural Resources
17. True
18. True
19. Animal Welfare Act of 1976  
Act 224 of 1969, Use of Dogs and Cats For Research  
Act 287 of 1969, Pet Shops, Dog Pounds, and Animal Shelters

## Chapter 2 – Pests and Integrated Pest Management (IPM)

1. Adult insects have three body regions: head, thorax and abdomen, and three pairs of legs.
2. b
3. c
4. An organism the pest is associated with.
5. True
6. Dermatitis is the direct damage and inflammatory reactions of animal skin caused by arthropod bites and body secretions.
7. The four groups of important animal insect pests are:
  - biting and non-biting flies.
  - invasive flies.
  - chewing and sucking lice.
  - fleas.
8. Integrated pest management—the use of all available strategies to manage pests so that an acceptable yield and quality can be achieved economically with the least disruption to the environment.
  1. Detection, 2. Identification, 3. Economic or medical significance, 4. Control method selection, and 5. Evaluation.
9. Early detection of small pests:
  - allows the manager more control options.
  - reduces animal discomfort by preventing increased pest populations.
10. Identifying the pest allows the animal manager to gather information about that particular pest (life cycle, biology) so that the pest's susceptible life stage can be targeted for control.
11. Economic injury levels are most important in agricultural settings (livestock, etc.).
12. The fifth step in IPM is evaluation of the pest control method used.
13. The applicator must consider dose-response relationships and pesticide choice.
14. IPM strategies include:
  - biological* – use of predators and parasites.
  - cultural* – keep pet well groomed and its environment clean, provide adequate diet and exercise.
  - mechanical*- groom pets, vacuum area regularly, use lights to attract pests away from animals.

*physical* – sticky flypaper, separate animals, clean up after infested animals.

*pest-resistant breeds* – use breeds of animals that are resistant to certain conditions and characteristics of that area.

*sanitation* – keep kennels, pet exercise areas, houses and bedding clean.

*quarantines* – isolate a new animal to confirm it is pest-free.

*chemical*- pesticides.

### Chapter 3 – Pesticides

1. e
2. 1. Types of pests managed, 2. How pesticides work, 3. Pesticide chemistry, 4. Pesticide formulations.
3. insects
4. e
5. True
6. Tremors, vomiting, salivation, ataxia, loss of appetite, diarrhea, seizures, breathing difficulty, weakness, death.
7. Organophosphates and carbamates. A wide range of insects including fleas, ticks, mites and lice.
8. True
9. False
10. b
11. Contact pesticides kill pests when they come into contact with them; systemic pesticides are absorbed by one part of the animal or plant and then are distributed internally to other parts of the plant or animal to kill the pest.
12. a
13. True
14. Chlorinated hydrocarbons, organophosphates, carbamates, synthetic pyrethroids.
15. A premise spray will persist in an animal's living area for a long period of time. A space or area spray does not have residual qualities and kills only the pests present at the time of application.
16. Identify the pest to be sure the product is effective in controlling it; determine if the

product is labeled for use on small animals; determine if there are use restrictions for certain animals, such as young ones or cats; type and percentage of active ingredient; toxicity; formulation; equipment required to make the application; requirements for retreatment.

17. An incompatible mixture of pesticides is either ineffective or unsafe for the applicator or the animal being treated.
18. Physical, chemical, host tolerance, timing and timing incompatibility. See these sections of the chapter for definitions.
19. On the pesticide label.
20. Nontarget organisms may be people, animals, insects or plants that are not intended to be treated or exposed to a pesticide application.

### Chapter 4 – Pesticides and the Environment

1. Any of the following: adsorption, absorption, volatilization, runoff, leaching, microbial degradation, chemical degradation, photodegradation.
2. False—vapor drift is not visible.
3. Run-off; leaching
4. aquifers.
5. The rate of breakdown will be slower because of less available light, heat and oxygen.
6. Point source contamination is from a discharge at a single location. Nonpoint sources include land runoff, precipitation, acid rain and percolation.
7. Prevention
8. See section titled “Keeping Pesticides Out of Groundwater” in the chapter.
9. c
10. Animals eat granules, baits or treated seed; they become exposed directly to a spray; they eat the treated crop or contaminated water; they feed on pesticide-contaminated prey.

### Chapter 5 – Pesticides and Human Health

1. Toxicity measures the capacity of a pesticide to cause injury. Hazard is the potential for injury.

2. True. Wear a hat or face shield.
3. False
4. Children
5. Inhaling pesticides during mixing, loading or application. Any activity where pesticides enter the mouth, such as siphoning a pesticide with your mouth, or eating or drinking while working with pesticides.
6. Chronic, acute
7. e
8. b
9. b
10. Pesticide label
11. Organophosphates, carbamates
12. Cholinesterase
13. People who work with organophosphates or carbamates for an extended time.
14. Pesticide label
15. Remove contaminated clothing; drench skin with water, wash with soap and rinse twice; dry and wrap person in a blanket; cover chemical burns with a loose, clean, soft cloth.
16. e
17. Get to fresh air; loosen tight clothing; give mouth-to-mouth resuscitation if needed; keep victim quiet; prevent chilling.
18. Toxicity, exposure
19. False
20. d
21. Wash clothing at the end of each day of use.
22. True
7. During mixing, you may see excessive clumping, poor suspension, layering or abnormal coloration. The target pest may not be controlled.
8. Apply the pesticide in a recommended manner listed on the label.
9. See the section titled "Cleaning and Disposing of Containers."
10. Michigan Department of Natural Resources Waste Management Division
11. False
12. Securely in the back of a truck.
13. True
14. Pesticides containing oils or petroleum solvents.
15. Any of the points listed under the section "Pesticide Fire Safety."
16. Clear everyone from the area.

## Chapter 6 – Pesticide Handling, Storage and Disposal

1. False
2. 5.0, 7.0
3. See the section titled "Storage Area."
4. b
5. True
6. The date will help you determine if the pesticide is too old to be effective and allows you to use older products first.

## Chapter 7 – The Label

1. True
2. True
3. False
4. d
5. False
6. True
7. Health and safety information about a particular pesticide. They are available from chemical dealers.
8. Yes
9. No
10. d
11. False
12. Yes. Birds, fish and bees.
13. False

## Chapter 8 – Fleas

1. True
2. An allergic condition that can be brought on by a single flea bite in an allergic or sensitized animal.

3. “Hot spots” occur when the animal continually scratches at highly inflamed sites on the skin caused by flea bites, creating conditions for bacterial infection. A hot spot is painful to the animal and may exude pus.
4. False
5. A few eggs per day and several hundred over the course of her life.
6. True
7. d
8. Treating for fleas on the host animal and in the host’s environment at the same time.
9. True
10. It is an illegal use of the products and can harm you, your family or your pets by creating dusts or fumes that could be inhaled.
11. They prevent flea larvae from developing to the adult stage.
12. fires or explosions.
8. True
9. They occur in cats and rabbits but also occasionally in dogs.
10. Detection and identification of non-burrowing mange mites requires skin scrapings.
11. True
12. True
13. In the scaly skin condition, skin thickens and wrinkles and hair falls out. Skin turns color from normal to red or bruised-looking. In the pustular skin condition, pimples or pustules filled with pus develop. The pustules can develop into severe abscesses or nodules filled with fluid and pus. This skin condition usually develops after the scaly condition and reflects the development of secondary bacterial infections in the follicles. In both conditions, itching occurs.
14. These skin conditions are collectively called demodectic mange.
15. True
16. False
17. 1. they cause blood loss, 2. their feeding causes inflammation and irritation of the skin, 3. they may stimulate hypersensitive allergic reactions, 4. they may cause a toxic reaction in the host, complicated by paralysis (called “tick paralysis”), and 5. they transmit microorganisms that cause disease.

## Chapter 9 – Mites and Ticks

1. 1. four pairs of legs (insects have three pairs);  
2. two major body units—the cephalothorax and the abdomen—while insects have three body units—head, thorax and abdomen.
2. 1. by damaging tissues and causing dermatitis; 2. by causing blood or body fluid loss; 3. by causing allergic reactions; or 4). by creating conditions for secondary bacterial infection.
3. Mange or scabies. Mange is a deterioration of the skin’s condition, leading to hair or feather loss, skin often disfiguring, and in severe cases, lethargy and weakness.
4. Mites mate and the females lay eggs. Eggs hatch and six-legged larvae emerge. Larvae feed and molt to the eight-legged nymph. Later, after feeding, the nymphs molt and become adult male or female mites.
5. As little as eight days to as long as four weeks, depending on the species of mite and temperature and humidity.
6. Because of their burrowing behavior and feeding.
7. True
18. True
19. True
20. On animals, tick control can be achieved using approved acaricides by dipping, spraying the entire animal or applying whole animal dusts.

## Chapter 10 – Chewing and Sucking Lice

1. Sucking lice feed on blood. Their mouthparts penetrate the skin of an animal and they draw the food from blood vessels.
2. False
3. The head of a sucking louse is narrower than the thorax.  
The head of a chewing louse is wider than the thorax.
4. Grooming; animal’s immune system can help protect against lice.

5. If parents, especially the mother, do not have lice, offspring will not risk infestation through exposure to them.
6. life cycle

## Chapter 11 – Flies

1. One
2. Blood-feeding flies not associated with manure or animal waste.  
Filth flies associated with animal waste or manure.  
Parasitic bot flies.
3. Worm-like and may be true maggots.
4. Mosquitoes, black flies, biting midges, deer flies and horse flies are blood-feeding flies.

5. All of them
6. True
7.
  1. Modification of the habitat and environment to reduce the sources of the flies.
  2. Separate animals from the flies through physical means— i.e., keep animals indoors when flies are biting.
  3. Use of repellents on the bodies of animals and insecticides applied to the animals directly or in their immediate environment where the flies occur.
8. They degrade manure to simpler components and reduce the volume of waste material.
9. True
10. Space or area sprays typically control flies at the time of application, whereas residual sprays offer longer control activity.

---

# GLOSSARY

**Acari** – Scientific grouping of organisms within the class Arachnida, including mites and ticks.

**Acariasis** – Veterinary term for an infestation of mites in or on an animal.

**Acaricides** – Pesticides that control mites or ticks.

**Active immunity** – Immunity (antibodies and immune cells) developed by an animal in response to a disease challenge or a vaccine antigen, as opposed to passive immunity, which is immunity conferred by the mother through internal antibodies. Active immunity is long-lived. Passive immunity is short-lived.

**Active ingredient (a.i.)** – The chemical(s) in a formulated product that is (are) principally responsible for the pesticidal effects and that is (are) shown as active ingredient(s) on pesticide labels.

**Acute exposure** – Exposure to a single dose of pesticide.

**Acute toxicity** – The quality or potential of a substance to cause injury or illness shortly after exposure to a relatively high dose.

**Additive** – A chemical added to a pesticide formulation to increase its effectiveness or safety; same as adjuvant.

**Adsorption** – The process by which a pesticide bonds with a surface; e.g., a soil colloidal surface.

**Adulterated** – (1) A pesticide whose strength or purity falls below that specified on the label. (2) A food, feed or product that contains illegal pesticide residues.

**Agitation** – The process of stirring or mixing in a sprayer.

**Agricultural animals** – Those used for production of food and fiber; livestock.

**Allergic effects statement** – A statement on a pesticide label that tells whether tests or other data indicate that a pesticide product has the potential to cause allergic effects, such as skin irritation or asthma. Sometimes the labeling refers to allergic effects as “sensitization.”

**Allergies** – Hypersensitivity to substances that are harmless to most other individuals.

**Alopecia** – Hair, feather or wool loss: may be due to any of a variety of causes. Complete loss of hair is usually a hormonal problem.

**Amitraz** – A formamidine chemical with insecticidal and acaricidal properties.

**Anaphylactic shock** – An often severe and sometimes fatal systemic reaction in a susceptible animal upon exposure to a specific antigen (such as wasp or fly venom) after previous sensitization; characterized especially by respiratory symptoms, fainting, and itching.

**Ancylostoma caninum** – Canine hookworm.

**Anemia** – Reduction or loss of red blood corpuscles.

**Anemic** – Weakened; lack of vitality due to blood loss or iron deficiency.

**Antagonism** – An interaction of two or more chemicals whose combined effect is less than the effect predicted on the basis of the activity of each chemical applied separately.

**Antibiotics** – Chemical substances that destroy or inhibit the growth of bacteria and some other organisms. A veterinarian may prescribe antibiotics for a viral disease to prevent secondary bacterial infections, but antibiotics do not affect the viruses themselves.

**Antidote** – A substance used as a medical treatment to counteract poisoning.

**Anti-siphoning device** – An attachment to the filling hose designed to prevent backward flow into the water source.

**Arachnids** – Organisms from the class Arachnida, such as spiders, mites and ticks.

**Ascarids** – Any of the genus of parasitic roundworms.

**Attractants** – Substances that lure insects to traps or to poison-bait stations; bait.

**Bacteria** – Extremely small, single-celled microorganisms that usually lack chlorophyll, reproduce by fission (splitting of the cell into two equal halves) and may cause diseases.

**Bioaccumulation** – The buildup of pesticides or other chemicals in the bodies of animals (including humans), particularly in fat tissue.

**Biological controls** – Control by pathogens, predators and parasites, either naturally occurring or introduced.

**Biotic** – Relating to living organisms.

**Biotype** – A population within a species that has distinct genetic variation.

**Bitch** – Female canine.

**Bordetella** – Infectious bacterium that can cause tracheobronchitis.

**Botanicals** – An insecticide/acaricide class that includes rotenone and pyrethrin, which are derived from plants; they may be synergized in certain formulations with PBO.

**Broad-spectrum pesticide** – A pesticide that is effective against a wide range of species.

**Bronchitis** – Inflammation of the bronchial passages (branches of the windpipe and passages in the lungs).

**Calibration** – The process of equipment adjustment to obtain a desired application rate and distribution.

**Carbamates** – An insecticide/acaricide class similar to organophosphates in activity; includes carbaryl and methomyl.

**Carcinogenic** – Capable of causing cancer in animals or humans.

**Carrier** – A gas, liquid or solid substance used to dilute, propel or suspend a pesticide during its application.

**Chemical degradation** – The breakdown of a pesticide by oxidation, reduction, hydrolysis or other chemical means.

**Chemical name** – Name applied to a pesticide active ingredient that describes its chemical structure according to rules prescribed by the American Chemical Society and published in the Chemical Abstracts Indexes.

**Cherry eye** – Swollen gland of the third eyelid of an animal that is visible as a large red mass on the inner corner of the eyelids.

**Chigger** – A six-legged mite larva that sucks the blood of vertebrates and causes intense irritation.

**Chlorinated hydrocarbons** – An insecticide/acaricide class that includes lindane, methoxychlor and naled.

**Chorioptic mange** – Veterinary term for infestation of *Chorioptes bovis*, a species of non-burrowing mange mites.

**Cholinesterase** – An enzyme that helps to control the transmission of nerve impulses in animals and humans.

**Chronic exposure** – Exposure to repeated doses of a pesticide over a period of time.

**Chronic toxicity** – Quality or potential of a substance to cause injury or illness after repeated exposure over an extended period of time.

**Closed mixing systems** – Systems in which liquid pesticide concentrates are transferred from their original containers to mix or spray tanks through a closed series of hoses, pipes, etc. Such systems are designed to prevent or minimize human exposure to the concentrates.

**Coccidia** – Parasitic protozoan that infests the digestive tract and can cause blood-tinged diarrhea in young puppies.

**Colostrum** – Mammary secretion containing antibodies of the bitch. Puppies receive this fluid upon the first suckling and receive maternal antibodies and passive immunity to those diseases to which the bitch has immunity.

**Comatose** – Inactive, as in a coma.

**Common name** – (1) When referring to a pesticide, an abbreviated name applied to a herbicide active ingredient; usually agreed upon by the American National Standards Institute and the International Organization for Standardization. (2) When referring to an organism, a name derived from local common usage that is agreed upon by some accepted authority but may not be unique.

**Companion animals** – Pets such as dogs and cats.

**Compatibility** – Mixable in the formulation or in the spray tank for application in the same carrier without undesirable alterations in the characteristics or effects of the individual components.

**Concentration** – The amount of active ingredient or herbicide equivalent in a quantity of diluent expressed as percent, pounds per gallon (lb/gal), kilograms per liter (kg/l), etc.

**Congenital** – Condition existing at time of birth.

**Cross-contamination** – When one pesticide gets into or mixes with another pesticide accidentally; usually occurs in a pesticide container or in a poorly cleaned sprayer.

**Cultural control** – Control by changing management practices to reduce pest numbers without using pesticides; includes maintaining overall good health of animals.

**Degradation** – The breakdown of a pesticide into a simpler compound that is usually, but not always, non-toxic; may be either chemical, physical or biological or any combination of the three.

**Dehydration** – Caused by insufficient fluid intake or abnormal loss of fluids.

**Dew claws** – Claws high on the inner side of dogs' legs that serve no useful function for most breeds. Consult veterinarian regarding removal.

**Demodectic mange** – A variety of skin conditions caused by an infestation of follicle mites.

**Dermatitis** – The direct damage and inflammatory reaction of an animal's skin to arthropod bites or body secretions.

**Detection** – The first step in an IPM program; requires thorough and regular monitoring of animals for pest infestations or other signs and symptoms that indicate a pest is present on the animal or in the animal's environment.

**Diluent** – Any gas, liquid or solid material used to reduce the concentration of an active ingredient in a pesticide formulation.

**Dilute** – To make less concentrated by adding water, another liquid or a solid.

**Directed application** – Precise application to a specific area.

**Dirofilaria immitis** – Canine heartworm.

**Disinfection** – Disinfection is the act of maintaining animals and birds in an environment that is cleaned and sanitized daily, including kennels, doors, grids, eating bowls, water bottles, walls, ceiling, floors, food utensils, isolation areas, puppy rooms, runs, exercise areas and examination areas. Maintenance personnel should wear clean clothes daily and wash hands and arms after handling any animals with a disease problem.

**Dispersible granule** – A dry, granular formulation that will separate or disperse to form a suspension when added to water.

**Distemper** – Common worldwide disease of dogs caused by canine distemper virus.

**Dock** – Shorten tail by cutting.

**Dog** – Male canine.

**Dose** – (1) Amount, quantity or portion of a pesticide that is applied to a target. (2) A measure of exposure used in animal testing to determine acute and chronic toxicities; usually expressed in milligrams per kilogram of body weight.

**Drift** – (1) The movement of pesticides through the air to non-target areas, either as solid or liquid particles or as vapors. (2) (Legal definition) The drifting or movement of pesticide by air currents or diffusion onto property beyond the boundaries of the target area to be treated with pesticide, other than by pesticide overspray.

**Dust** – A dry pesticide formulation.

**Ear mites** – Parasite that inhabits the ear canal and feeds by piercing the skin. Mites are visible to the naked eye. Ear mite infestation can be suspected if the ear passage contains a dark brown exudate with a characteristic odor.

**Eastern equine encephalitis** – Disease of horses, pheasants and humans caused by a virus transmitted by swamp mosquitoes among wild birds.

**Ecto** – Prefix meaning “outside of the body.”

**Ectoparasite** – Organism that lives on the outside of the host body, more or less in permanent association.

**Ecology** – The science that studies the interrelationships of living organisms and their environment.

**Economic damage** – The amount of injury that will justify the cost of applied control measures.

**Efficacy** – Effectiveness of a vaccine, pesticide or medication.

**Emulsifier** – A surface-active substance that promotes the suspension of one liquid in another; e.g., a chemical that allows a petroleum-based pesticide to mix with water.

**Emulsion** – The suspension of one liquid as minute globules in another liquid; e.g., oil dispersed in water.

**Encapsulated formulation** – A pesticide enclosed in capsules or beads of thin polyvinyl or other material to control the rate of release of the chemical and thereby extend the period of activity.

**Endangered species** – A group of organisms on the brink of extinction.

**Endo** – Prefix meaning “inside the body.”

**Endoparasite** – Organism that invades internal body parts of the host.

**EPA** – Environmental Protection Agency.

**Eradication** – The complete elimination of a pest from a site, an area or a geographic region.

**Euthanize** – Destroy in a humane manner.

**Exotic** – Native to other regions, countries or continents.

**Facultative myiasis** – Infestation by flies that are attracted to and lay eggs in wounds or injuries on animals.

**FDA** – Food and Drug Administration.

**FIFRA** – The Federal Insecticide, Fungicide and Rodenticide Act — The federal law dealing with pesticide regulations and use.

**Flowable (F or L)** – A pesticide formulation in which the active ingredient is impregnated on a diluent such as clay that is then finely ground and suspended in a small amount of liquid; the resulting paste or cream-like formulation is added to water in the spray tank and forms a suspension.

**Food chain** – A group of plants, animals and/or microorganisms linked together as sources and consumers of food.

**Formulation** – (1) A pesticidal preparation supplied by a manufacturer for practical use. (2) The process, carried out by manufacturers, of preparing pesticides for practical use.

**Fowl pox** – Viral disease of domestic fowl and wild birds.

**Fungus** – A largely undifferentiated, usually microscopic organism lacking chlorophyll and conductive tissues and living either as a saprophyte or a parasite. The vegetative body of a fungus is normally composed of hyphae, and reproduction is by sexual and/or asexual spores.

**GPA** – Gallons per acre.

**GPM** – Gallons per minute.

**Granule or granulation** – A dry formulation of pesticide and other components in discrete particles, generally less than 10 cubic millimeters, and designed to be applied without a liquid carrier.

**Growth regulator** – A substance used for controlling or modifying insect or plant growth processes.

**Hazard** – The risk of harmful effects. Hazard depends on both the toxicity of the substance and the exposure received in a given situation.

**Health certificate** – Document signed by a veterinarian that states an animal is free of clinical evidence of disease. Considered in most states to be an official document.

**Heartworm** – Thread-like worms (*Dirofilaria immitis*) that reside mostly in the right ventricle of the heart; transmitted by mosquitoes. Prevention possible.

**Herbicide** – A chemical used to control, suppress or kill plants or to severely interrupt their normal growth process.

**Hereditary defect** – Abnormal condition of the sire or dam, or of past generations of the sire or dam, that may be passed on to the current generation of animals.

**Hookworms** – An endoparasite (*Ancylostoma caninum*) that attaches to the intestinal wall and ingests blood. Infestation can lead to severe anemia and death.

**Hormone mimics** – A class of insecticides that prevents development of immature insects to the adult stage. These chemicals simulate the activity of juvenile hormone, the hormone in insects that maintains immature characteristics. (See insect growth regulator.)

**Host** – Organism on which a pest is located.

**Hypersensitivity** – An extreme allergic reaction to insect bites, stings or secretions.

**Hypostome** – Feeding apparatus of a mite.

**Immunized** – Creation of antibody levels high enough to prevent a disease.

**Incompatibility** – When two or more pesticides cannot be effectively mixed without a loss in activity, an increase in toxicity or hazard to the applicator, or harm to the crop or the environment.

**Incubation** – Period of time between exposure to disease and development of clinical evidence of the disease.

**Inert ingredients** – The materials in a pesticide formulation that have no pesticide activity.

**Ingestion** – Eating or swallowing.

**Ingredient name** – The active ingredients and the amount of each ingredient (as a percentage of the total product) in a pesticide listed by the official chemical name and/or common name for each active ingredient.

**Inhalation toxicity** – A measure of the capacity of a pesticide to cause injury when absorbed through the lungs.

**Inoculation** – Injection of a vaccine or bacterium.

**Inorganic pesticides** – Pesticides of mineral origin—they do not contain carbon.

**Insecticide** – A chemical used to control insects.

**Insect growth regulators** – A class of insecticides that prevent development of immature insects to the adult stage.

**Integrated pest management** – An ecological approach to pest management that consolidates all available necessary techniques into a unified program to manage pest populations so as to avoid economic damage and minimize adverse effects to the environment and nontarget organisms.

**Intermediate host** – A host that is usually used by a parasite in the course of its life cycle and in which it may multiply.

**Intranasal** – Administration of antigen via nasal passages.

**Invertebrates** – A class of animals that lack spinal cords.

**Ivermectins** – Group of insecticides labeled as drugs, that often come into use for pest control on animals.

**Isolate** – Set apart to prevent disease transmission.

**Isolation area** – An area or caging constructed to prevent spread of contagious conditions. The area or cage should have a ventilation system that prevents commingling of air from the isolation area with air in the healthy animal area.

**Label** – The information printed on or attached to the pesticide container or wrapper.

**Labeling** – The pesticide label and all additional product information provided by the manufacturer such as brochures and flyers provided by the dealer.

**Larva** – The immature stage of an insect.

**Larvicide** – A pesticide that controls immature insects.

**LC50** – The concentration of a chemical in air (inhalation toxicity) or water (aquatic toxicity) that will kill 50 percent of the organisms in a specific test situation.

**LD50** – The dose (quantity) of a chemical calculated to be lethal to 50 percent of the organisms in a specific test situation. It is expressed in weight of the chemical (mg) per unit of body weight (kg) of the test organism. The toxicant may be fed (oral LD50) or applied to the skin (dermal LD50).

**Leaching** – Downward movement of a pesticide or other soluble material through the soil as a result of water movement.

**Lesions** – Damage to an organ or tissue.

**Lethal** – Causing or capable of causing death.

**Lethargy** – Lack of energy, drowsy, dull, sluggish or inactive.

**Life cycle** – The progression of stages in the development of an organism.

**Lime sulfur** – Inorganic chemical (calcium polysulfide) used for lice control.

**Mange** – Deterioration of the skin's condition, leading to hair or feather loss, skin discoloration, often disfiguring and, in severe cases, lethargy and weakness. Associated with mite infestation.

**Material Safety Data Sheets (MSDS)** – These data sheets contain specific information on toxicity, first aid, personal protection equipment, storage and handling precautions, spill and leak cleanup and disposal practices, transportation, physical data and reactivity data. MSDS are available from manufacturers.

**Mechanical control** – Pest control by physically altering the environment; e.g., use of screens as barriers to insects.

**Metabolite** – A compound derived from metabolic transformation of a chemical by plants or other organisms.

**Microfilaria** – Immature stages of canine heartworm that circulate in the blood.

**Microorganism** – An organism that is so small that it cannot be seen without the aid of a microscope.

**Mineral oil** – Barrier against biting flies; also a diluent in some ear mite treatments that contain carbaryl.

**Miticide** – Pesticide that controls mites.

**Mode of action** – The way in which a pesticide exerts a toxic effect.

**Monitoring** – The process of information gathering and collection through observation of a site or target organism.

**Mucopurulent** – White or yellowish discharge containing mucus and pus, typically seen from the eyes or nose.

**Natural enemies** – The predators and parasites that attack a species.

**Neoprene** – A synthetic rubber.

**Nits** – The eggs of lice.

**Nontarget species** – Species not intentionally affected by a pesticide.

**Nymphs** – Larvae that emerge from insect eggs of many insects and arthropods.

**Obligatory myiasis** – Infestation of bot flies in animals occurring when the larval stages are living inside the skin or tissues of the animal.

**Ocular** – Pertaining to the eye.

**Oncogenic** – Capable of producing or inducing tumors in animals, either benign (non-cancerous) or malignant (cancerous).

**Oral toxicity** – A measure of the capacity of a pesticide to cause injury when taken by mouth.

**Organic pesticides** – Pesticides that contain carbon. Most are synthetic; some are derived or extracted from plants.

**Organophosphates** – An insecticide/acaricide class that includes chlorpyrifos, malathion, DDVP, ronnel, stiriphos and others. They range from acutely mildly to toxic to animals.

**Parainfluenza** – Pneumonia-like infection caused by canine parainfluenza virus.

**Parasite** – Plant or animal that lives in or on another organism.

**Parts per million, weight (PPMW)** – One part of a substance in one million parts of another substance, by weight.

**Parasiticide** – Substance that kills parasites.

**Parvovirus** – Virus that attacks growing tissues (especially the intestinal tract) in puppies that are not immunized.

**Passive immunity** – Immunity not of the young animal's own making, for example from maternal antibodies that offer only temporary protection.

**Patella** – Kneecap.

**Pelleted formulation** – A dry formulation of pesticide and other components in discrete particles, usually larger than 10 cubic millimeters, and designed to be applied without a liquid carrier.

**Personal protective equipment (PPE)** – Clothing and devices worn to protect the human body from contact with pesticides or pesticide residues.

**Pesticide interaction** – The action or influence of one pesticide upon another and the combined effect of the pesticide on the pest(s) or crop system.

**Physical control** – Control for animal pests that may include the use of sticky flypaper to reduce nuisance flying insects in confined areas.

**Pour-ons** – High-concentrate, low-volume pesticide formulations applied directly to animals from the containers they are purchased in.

**Premise spray** – An insecticide that will persist on the surfaces in an animal's living area for a period of time.

**Psoroptic mange** – Veterinary term for infestation of *Psoroptes ovis*, species of non-burrowing mange mites.

**pH** – A measure of the acidity or alkalinity of a solution.

**Photodecomposition** – Degradation of a pesticide by light.

**Phytotoxic** – Injurious or lethal to plants.

**PPB** – Parts per billion. One ppb equals 1 pound in 500,000 tons.

**PPM** – Parts per million. One ppm equals 1 pound in 500 tons.

**PPT** – Parts per trillion. One ppt equals 1 pound in 500,000,000 tons.

**Precipitate** – A solid substance that will no longer remain dissolved in water because of some physical or chemical process.

**Predator** – An animal that attacks, kills and feeds on other animals.

**PSI** – Pounds per square inch.

**Psittacines** – Birds related to parrots.

**Pustules** – Eruptions containing pus, such as boils or pimples.

**Rabies** – Virus that affects the central nervous system.

**Rate** – The amount of active ingredient applied per unit area or other treatment unit.

**RCRA** – The Resource Conservation and Recovery Act, the federal law regulating the transport, storage, treatment and disposal of hazardous wastes.

**Ready to use** – Formulation requiring no mixing or combining with other ingredients or diluents and applied directly from the manufacturer's container.

**Registration** – The regulatory process designated by FIFRA and conducted by the EPA through which a pesticide is legally approved for use.

**Repellents** – A class of insecticide/acaricide that helps prevent animal pest establishment, though repellents are not always insecticides—diethyl-meta-toluamide (DEET), butoxypolypropylene glycol, and dipropyl isocinchomeronate are repellents that have activity against certain arthropods.

**Residue** – That quantity of a pesticide remaining in or on the soil, plant tissue, animal tissue, whole organisms and surfaces after an application.

**Restricted use pesticide** – A pesticide that may be used only by a certified applicator. It is designated as such by the Environmental Protection Agency because of its potential to cause unreasonable adverse effects on the environment, including injury to the applicator.

**Resurgence** – A dramatic increase in the population level of a target pest some time after a pesticide application because the pesticide destroyed its natural enemies. Pest numbers may soon surpass pretreatment levels.

**Ringworm** – Ring-shaped patch on skin caused by a fungus.

**Roundworm** – Internal parasitic worm (ascarid).

**Runoff** – Movement of water carrying with it other liquid compounds, soil with contaminants bound to it or both.

**Sarcoptic mange mite** – Parasite that burrows under the skin, causing intense itching; can be transmitted to people.

**Scabies** – Any skin condition of man or animal associated with a mite; a particularly serious, debilitating, mange condition.

**Scientific name** – The Latin name of the genus and species of an organism, designated by taxonomists and universally accepted. Scientific names are used to avoid the confusion that can result from the use of common names, which may vary from one area to another.

**Scouting** – Checking a crop or animal on a regular basis and in a prescribed manner to determine pest population levels and the extent of pest damage (monitoring).

**Sebaceous glands** – Oil glands.

**Secondary infection** – Infection that occurs following the primary infection, as a result of lowered immunity; e.g., infection following the scratching of flea bites.

**Selectivity** – The ability of a chemical to be more toxic to some species than to others; may be a function of dosage or mode of application.

**Self-limiting** – Refers to a disease or condition that will clear up by itself after a period of time.

**Shampoo** – Formulation of insecticide and other ingredients that is applied to an animal's wet fur and worked into a lather.

**Signal words** – The signal words DANGER, WARNING or CAUTION must appear, by law, in

large letters on the front panel of a pesticide label. They indicate how acutely toxic to humans the product is.

**Site** – The animal, crop or area infested by a pest and to which a pesticide is applied.

**Space spray** – Method of application of an insecticide that kills the insects that are in the area at the time of application.

**Spot-ons** – High-concentrate, low volume pesticide formulation applied directly to the animal from the container the product is sold in.

**Solubility** – The ability of a solid to dissolve in a liquid.

**Solution** – A homogeneous mixture of one or more substances (solutes) in another substance (solvent), which is usually a liquid. The solutes are completely dissolved and will not settle out or separate under normal conditions.

**Solvent** – A liquid in which one or more substances dissolve to form a true solution.

**Species** – The basic unit of taxonomic classification, designating a group of closely related individuals that are capable of interbreeding.

**Spot treatment** – Application of pesticides to limited area(s) of a whole unit; e.g., treatment of spots or patches of cracks and crevices within a larger kennel or building area.

**Spray drift** – Movement of airborne spray from the intended area of application.

**Staphylococcus** – Type of bacterium frequently associated with skin infection  
**Statement of practical treatment (first aid)** – Instructions on how to respond to an emergency exposure involving a pesticide product.

**Subclinical** – Not readily apparent disease.

**Surfactant** – A material that improves the emulsifying, dispersing, spreading, wetting or other surface-modifying properties of liquids.

**Susceptibility** – The sensitivity to or degree to which a plant is injured by a pesticide treatment. (See tolerance.)

**Suspension** – A mixture containing finely divided particles evenly dispersed in a solid, liquid or gas.

**Symptom** – (1) Any detectable change in an organism resulting from the activities of a pathogen or other pest. (2) An indication of pesticide poisoning.

**Synergism** – An interaction of two or more chemicals whose combined effect is greater than the

effect predicted on the basis of the activity of each chemical applied separately.

**Synergist** – Something that enhances the effectiveness of the active ingredient(s) in a formulation.

**Synthetic chemical** – A manufactured chemical.

**Synthetic pyrethroids** – A class of insecticides/acaricides—including permethrin, resmethrin and allethrin—that shows properties of low mammalian toxicity but good activity against insects, ticks and mites.

**Systemic pesticide** – A chemical that is absorbed and translocated (moved) within a plant or animal.

**Tapeworm** – Intestinal parasitic worm (Cestode).

**Tank-mix combination** – Mixing two or more pesticides in the spray tank at the time of application.

**Target organism** – The pest against which a particular pesticide or other control method is directed.

**Taxonomy** – The classification of living organisms into groups on the basis of similarities and relationships.

**Terrestrial** – Living or growing on land; not aquatic.

**Tolerance** – (1) Capacity to withstand pesticide treatment without marked deviation from normal growth or function. (See susceptibility.) (2) The concentration of pesticide residue that will be allowed in or on agricultural products.

**Topical** – External, upon the skin.

**Toxemia** – An abnormal condition associated with the presence of toxic substances in the blood.

**Toxicity** – The quality or potential of a substance to cause injury or illness.

**Toxicology** – The study of the principles or mechanisms of toxicity.

**Tracheobronchitis** – Upper respiratory infection. Common name is “kennel cough.”

**Trade name** – A trademark applied to a product such as a pesticide formulation by its manufacturer.

**Trichuris vulpis** – Endoparasite (whipworm) that attaches to the intestinal wall and ingests blood.

**Ulceration** – Open sore.

**USDA** – United States Department of Agriculture.

**Vaccine** – Antigens introduced into the body that stimulates the formation of protective immunity.

**Vapor drift** – The movement of chemical vapors from the area of application. Note: vapor injury and injury from spray drift are often difficult to distinguish.

**Venomous** – Having a venom-producing gland and able to inflict a poisoned wound.

**Vertebrate** – An animal with a spinal column.

**Viral** – Involving or relating to viruses.

**Virulent** – Highly infectious; capable of causing disease.

**Watershed** – The area of land draining into a body of water.

**Weed** – A plant growing where it is not desired; any plant that is objectionable or interferes with the activities or welfare of humans.

**Wettable powder (WP)** – A fine textured, dry pesticide formulation that can be suspended in water.

**Wetting agent** – (1) A substance that serves to reduce interfacial tensions and causes spray solutions or suspensions to make better contact with treated surfaces (see surfactant). (2) A substance in a wettable powder formulation that causes it to wet readily when added to water.

**Whipworm** – Internal parasite (*Trichuris vulpis*) that infests lower intestinal tract .

**Wipes** – Pesticide formulation applied directly to the animal; cloths or sponges saturated with the product.

**Woods lamp** – Ultraviolet light with an eye-protecting filter; helpful in identifying some kinds of ringworm.

(PLEASE POST IN AN APPROPRIATE PLACE)

# PESTICIDE EMERGENCY INFORMATION



For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.



Current as of May 1994

## Human Pesticide Poisoning

### Eastern Half of Michigan

\*(313) 745-5711

Poison Control Center  
Children's Hospital of Michigan  
3901 Beaubien  
Detroit, MI 48201

### Western Half of Michigan

Contact local hospital  
emergency room.

### Upper Peninsula of Michigan

within Marquette city proper:

\*(906) 225-3497

Upper Peninsula only:

\*1-800-562-9781

U.P. Poison Control Center  
Marquette General Hospital  
420 West Magnetic Street  
Marquette, MI 48955

## Special Pesticide Emergencies

### Animal Poisoning

Your veterinarian:

Phone No.  
or

Animal Health Diagnostic  
Laboratory (Toxicology)  
Michigan State University:  
(517) 355-0281

### Pesticide Fire

Local fire department:

Phone No.  
and

Fire Marshal Division,  
Michigan State Police:  
**M-F: 8-12, 1-5**  
(517) 322-5847

### Traffic Accident

Local police department or  
sheriff's department:

Phone No.  
and

Operations Division, Michi-  
gan State Police:  
\*(517) 336-6605

### Environmental Pollution

Pollution Emergency Alert-  
ing System (PEAS), Michi-  
gan Department of Natural  
Resources:

Phone No.  
and

For environmental emer-  
gencies:  
\*1-800-292-4706

### Pesticide disposal information

Michigan Department of Natural Resources.  
Waste Management Division.

**Monday - Friday: 8 a.m. - 5 p.m.**  
(517) 373-2730

### National Pesticide Telecommunications Network

Provides advice on recognizing and managing pesticide poi-  
soning, toxicology, general pesticide information and emer-  
gency response assistance, Funded by EPA, based at Texas  
Tech University Health Services Center.

**Monday - Friday: 8:00 a.m. - 6:00 p.m. Central Time Zone**  
1-800-858-7378

\* Telephone Number Operated 24 Hours

Michigan State University Extension  
Extension Bulletin AM-37  
(Revised May 1994 — Destroy previous editions)

Revised by  
Larry G. Olsen  
Pesticide Education Coordinator

**MICHIGAN STATE  
UNIVERSITY  
EXTENSION**

MSU is an Affirmative-Action Equal Opportunity Institution. Extension programs and materials are open to all without regard to race, color, national origin, sex, disability, age or religion. ■ Issued in furtherance of Extension work in agri- culture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agri- culture. Gail L. Imig, director, Michigan State University Extension, East Lansing, MI 48824.

